COMMUNICATIONS

COMPLETE DATA ON THE STAR SPANGLED NETWORK

THE APCO MEETING

REVIEW OF IRE PAPERS AT CLEVELAND CONVENTION

JULY

1942

Our Perseverance Pays Dividends to the National War Effort ...

The merits of graphite and its desirability as an anode material were recognized by Amperex more than a decade ago.

Through the years . . . despite the insistence and claims of other tube manufacturers in regard to the superiority of various rare and semi-precious metals . . . Amperex has consistently held to its conviction that graphite was the preferred material for anodes in high vacuum tubes.

We have demonstrated, during that period, the superiority of our anodes by developing almost 100 types of transmitting tubes that have found favor in commercial broadcasting, aviation and electro-medical fields, as well as tubes for applications in the high and hyper-high frequency range for the armed services of the United States and the United Nations.

With our country in dire need of the rare and semi-precious metals employed as anodes by other manufacturers. . . and with the demand for "military purpose" tubes climbing to staggering quantities . . . Amperex is proud of the fact that its perseverence in developing graphite as an anode substance releases strategically necessary metals for other and equally important War efforts.

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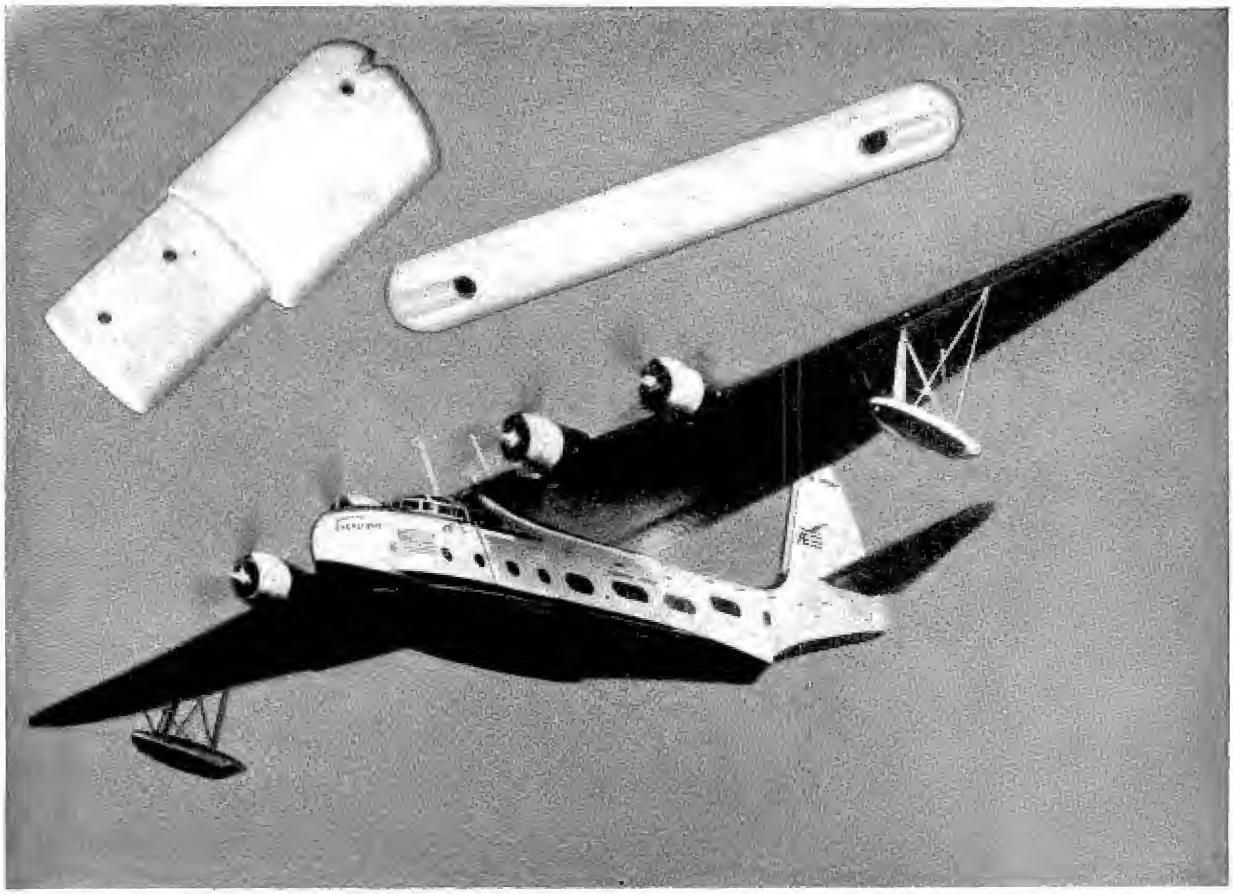
A GIANT FLYING BOAT TAKES TO THE SKIES ...AND ISOLANTITE INSULATION HELPS MAINTAIN VITAL COMMUNICATIONS LINKS



A NEW CHAPTER in aviation history was written with the launching of the EXCALIBUR, first of the Flying Aces built for American Export Airlines, Inc., by the Vought-Sikorsky Aircraft Division of United Aircraft Corporation.

Longest-range commercial aircraft ever built, the EXCALIBUR and its sister ships will soon be spanning the ocean in a new service, linking New York and Eire in non-stop flight.

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LEWIS WINNER, Editor
F. WALEN, Associate Editor

We See...

COMMUNICATIONS DEVELOPMENT TODAY has achieved heights of excellence never before realized. And not only in the military laboratory, as most are prone to assume, but in the standard laboratory too, throughout the Nation. Recent demonstrations of the Westinghouse engineers attested to this, in part. But particularly is this developmental stage in the rapid stages of progress, in the broadcast stations and in the university laboratories. Hundreds of newcomers and veterans too, inspired by the tense demands of the day . . . prompted by wartime measures, are creating an abundance of methods, designs and equipment. Many such developments are lured away by the military, but many, because of their intrinsic properties, are allowed to remain for use on the home front. We are fortunate enough to have seen such developments . . . in the laboratories . . . at engineering conventions . . . in the universities. And we're proud to say that it's an all-out effort on all fronts . . . to win for those at home and in the field!

IT'S NO NEWS that the WPB has accepted the suggested pooling plan of the BWC . . . formerly the DCB . . . *but it is news* that actually the plan is going to be put to work. Plenty of hard work is ahead . . . plenty of personal entanglements will be involved. But, notwithstanding, it should work. We believe so, since most of the boys want it to work . . . they want the help, and are willing to help. The few that don't . . . well . . . there are always a few who are quick to say nay . . . and suddenly find it doesn't pay! The best evidence that the plan should be successful comes from the recent swapping service inaugurated by NAB. Every week or so, NAB issues a swap bulletin, offering tubes . . . yes tubes . . . recorders, transformers, either for sale or swap. The list has grown from two listings to over a dozen. It's a new form of trading . . . and it's doing a good job.—L. W.

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JULY, 1942

VOLUME 22 NUMBER 7

COVER ILLUSTRATION

The first exclusive presentation of the new insignia for the Star Spangled Network created for the USO by H. M. Rundle, head of the art department of RCA Manufacturing, and prepared especially by him for this initial appearance in COMMUNICATIONS.

TRANSMITTER DEVELOPMENT

DESIGN AND APPLICATION

ENGINEERING CONVENTION RESUME

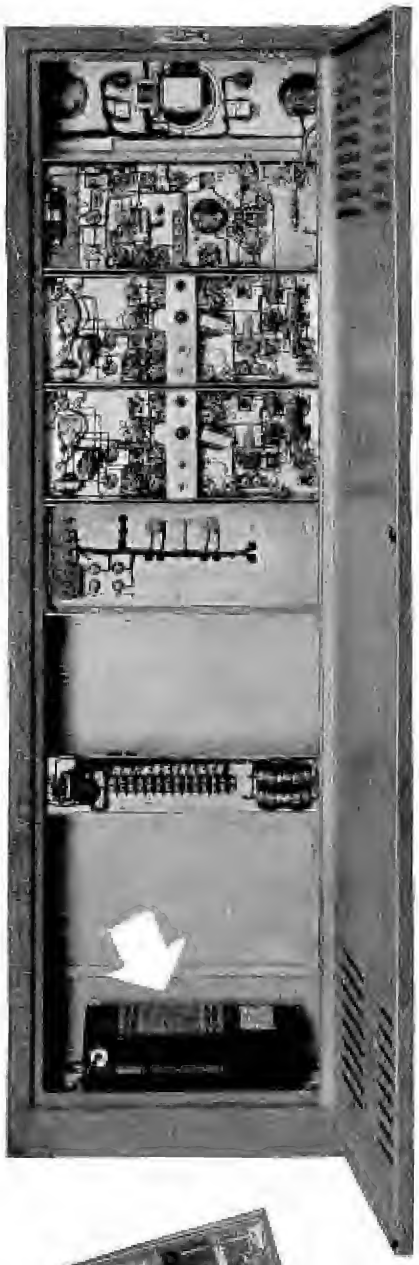
ENGINEERING MEETING PROGRAM

MONTHLY FEATURES

Published Monthly by the Bryan Davis Publishing Co., Inc.

BRYAN S. DAVIS, President — PAUL S. WEIL, Advertising Director
F. WALEN, Secretary — A. GOEBEL, Circulation Manager

Advertising and Editorial offices, 19 East 47th Street, New York City, Telephone PLaza 3-0483. Wellington, New Zealand, Te Aro Book Department. Melbourne, Australia, McGill's Agency. Entered as second-class matter October 1, 1937, at the Post Office at New York, N. Y., under the act of March 3, 1879. Yearly subscription rate: $2.00 in the United States and Canada, $3.00 in foreign countries. Single copies; twenty-five cents in United States and Canada, thirty-five cents in foreign countries.



ask for bulletin ECV-74

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keep these FM transmitters on the alert 24 hours a day

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CONSTANT VOLTAGE TRANSFORMERS

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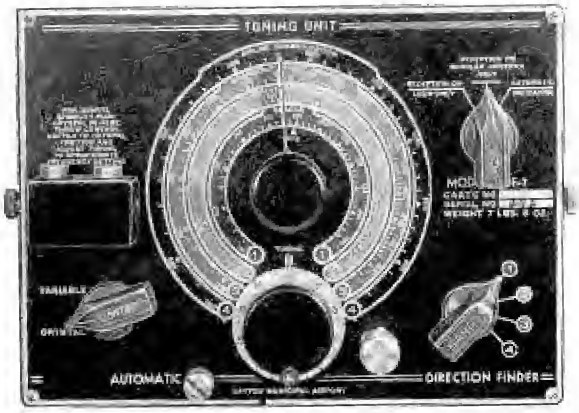
Approved Precision Products Help Keep Pilots Talking.. Listening..and Homing!



HOMING is made easier for many pilots because their ships are equipped with this automatic direction finder, which includes four electrolytic condensers and two selector switches made by Mallory.

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THE STAR SPANGLED NETWORK

by EMIL FRANK and DONALD PHILLIPS

ONE of the most important links in the vast wartime activities of the Nation today is the United Service Organizations . . . the USO . . . an achievement of millions of proud Americans. Assigned with the huge responsibility of providing "somewhere-to-go" and "something-to-do" for the millions of our armed forces during their moments of rest, the USO has built clubhouses, recreation halls, rest bunks, broadcasting studios in countless army, navy, marine, coast guard encampments. All types of facilities have been placed at the disposal of the boys, facilities that have spelled relaxation and comfort to the able as well as the ill.

Unique among these facilities is a recording and radio system . . . the Star Spangled Network . . . originated by the National Community Service, member agency of the USO . . . and providing a variety of educational and entertainment services never before possible. The system, conceived by Dr. Franklin Dunham, executive director of the NCCS and former educational director for the National Broadcasting Company, is divided into three divisions . . . the red, white and blue. The red division is devoted to the recording work; the white is devoted to powered line radio stations, and the blue is devoted to the mobile units.

The White Division

In the white division, we have the primary link, around which the network is based . . . wired radio. Wired radio, is in itself, nothing new, but in its present re-developed stage, it includes many new and unusual features. For, now, for instance, the system affords reception over any radio set on regular broadcast frequencies. It is now only necessary to plug in the receiver to the power line, tune to a specific frequency in the broadcast frequency spectrum, and listen in. This is in contrast to earlier systems that used low frequencies, such as 30 kc and required special receivers, or even systems used by power line companies that operate in the 200 to 300 kc region and depend on the radiated signal and not direct pick-up.

Martin Work, Consultant

To Martin Work, former director of radio at Loyola University of Los Angeles was given the assignment of radio consultant to the NCCS and the responsibility of adopting the wired radio

THE RED - - - THE WHITE - - and THE BLUE - -

Divisions of the Star Spangled Network

system as well as the other network features, to the cantonments. Outstanding results were achieved by Mr. Work in the very first installation at Madison Barracks.

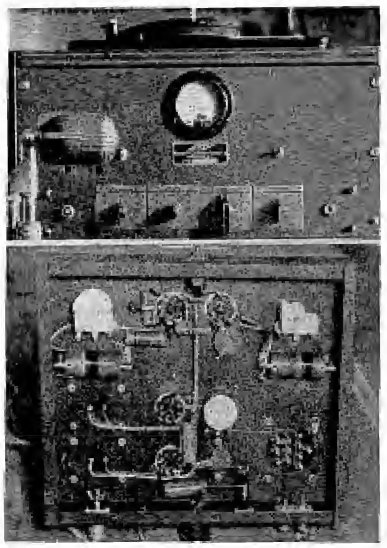
The Basic Installation

Basically this installation consists of a master amplifier in the main studio coupled to an automatic turntable, a microphone and a pair of headphones used for monitoring purposes. The microphone and turntable are arranged so that fades between selections, programs or announcements can be made. A leased line couples the output of the amplifier to a master oscillator transmitter, which has an output of 2 watts. The output of the transmitter is fed into the wiring lines of the camp.

Transmitter Coverage

The transmitter covers a frequency of from 870 to 2000 kc. A 6G6G is used as an electron coupled oscillator. The audio output is fed into a 35L6GT acting as a modulator, while another 35L6GT serves as a class C r-f amplifier. The power supply is of the self-contained type with a 35Z4GT as a rectifier.

The r-f output is matched to the a-c line via a variable condenser and induction coil, the input to the line being 110 volts at 20 watts. The r-f line from the transmitter to this matching arrangement was found to work best when the distance is under 200 feet. Extensions of the line required shielding and grounding to prevent radiation from the line.



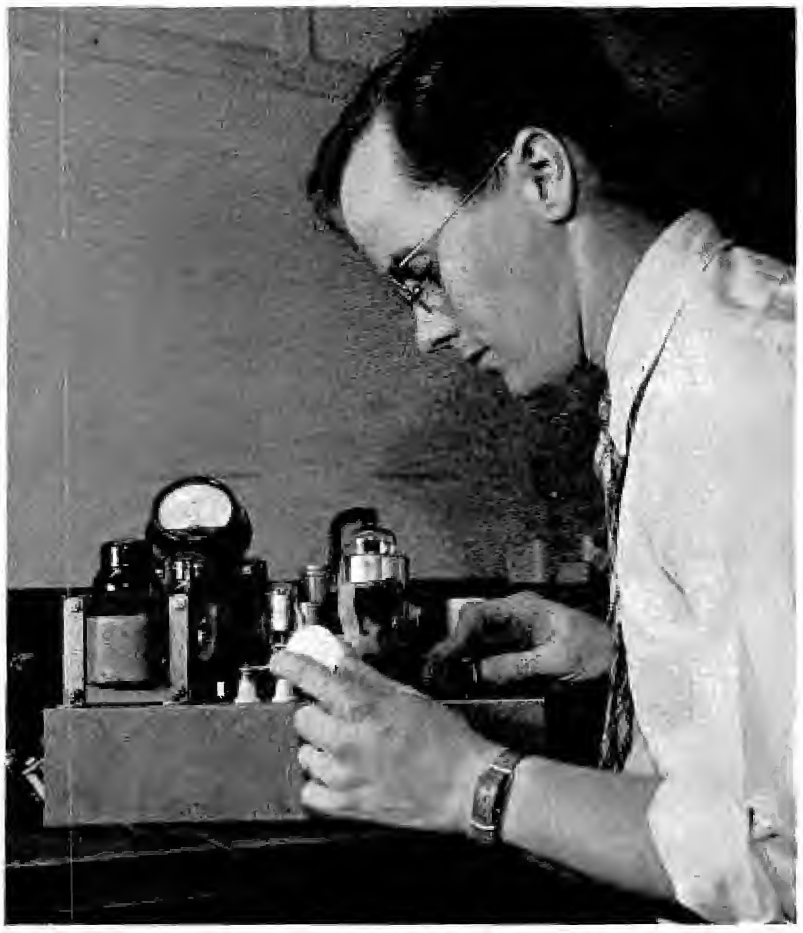
At top, we have a closeup of the first unit made and installed at Madison Barracks. Below is an underside view of the unit.

The studio amplifier system consists of a crystal microphone fed into a 6C5 linked as a microphone amplifier, a 6SC7 as a mixed amplifier, a 6L6 as a monitor speaker amplifier, and a 6C5 as output to the line. An 80 tube serves as a rectifier in the power supply unit. The a-f output from the amplifier is controlled by 500 ohm volume controls for the microphone, record player and master gain control.

Provision in the club studio is also made for an external speaker. The driving power for this speaker is furnished by the 6L6 which has its own 500 ohm control and operates independently of the master gain control. A phone jack connected across the 500 ohm output line affords monitoring the output to the transmitter.

Solving Link Problems

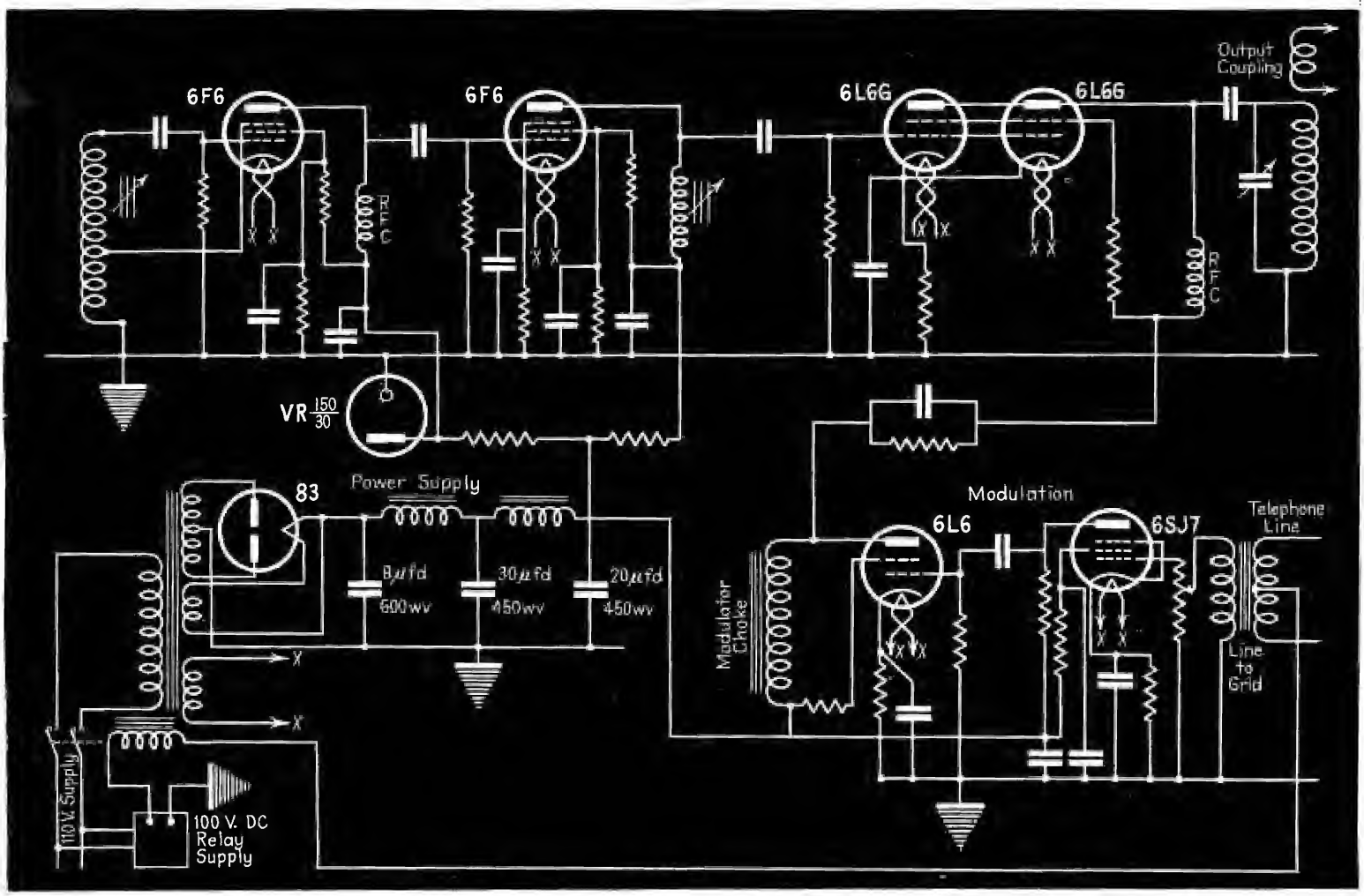
The club in which the wired unit is installed, is a quarter of a mile from the barracks. Inasmuch as it was advisable that the a-c line be as short as possible and under the 200 foot length, previously mentioned, it was found necessary to lease a 500 ohm telephone line to act as a link between amplifier and transmitter. This brought up a problem of having a man at each end of the line for transmitter control. The man at the transmitter would have had to turn the transmitter on and off as directed. However, this was solved by simply placing the transmitter in the telephone switchboard room. Under this arrangement, the telephone operator is called and asked to turn off or on the transmitter. Having the transmitter close to the telephone lines, also affords origination of the programs within the post grounds. The a-f amplifier is moved wherever the pickup is desired.



Tom Rowland, designer of the 20-watt transmitter unit, checking up on the modulation characteristics of this transmitter. The output meter shown at upper left appears on the instrument panel, in addition to the glow tube which Mr. Rowland is adjusting.

R-F and the Power Lines

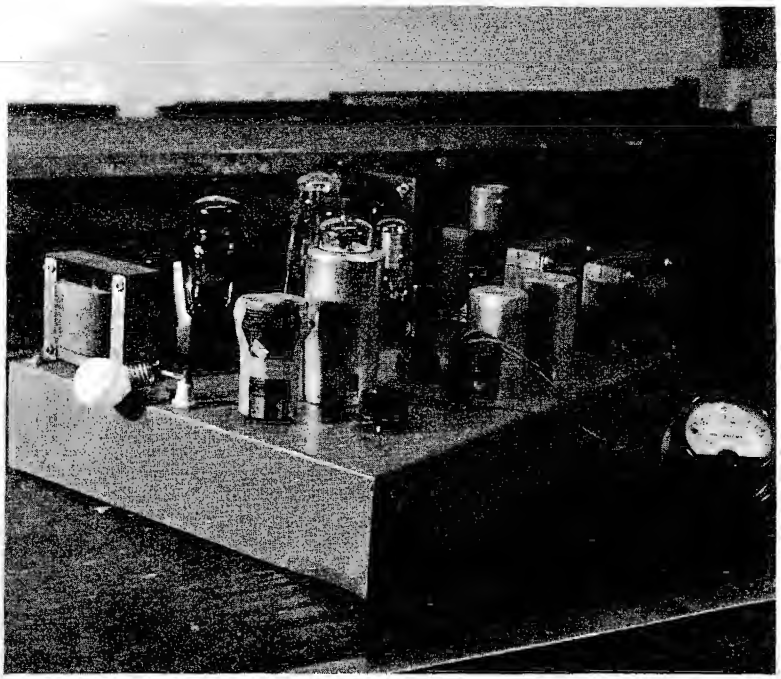
Although feeding r-f through a set of transformers on the power line presents quite a problem, at these barracks the problem was simplified, since they had one set of transformers of the 4000 to 110 volt type. However, many other camps where wired radio is to be installed, are not so fortunate. For, in some cases, the area to be covered ranges up to 40 square miles, and in addition the electric wiring system is for the most part, of the open line unshielded type. The power system in these points



begins at 46,000 or 23,000 volts, with step-down transformers all the way down the line, until finally there are a flock of 4000 to 110 volt transformers, with which to contend. Fortunately, a solution to most of these problems has been found by David Borst, technical manager of the Intercollegiate Broadcasting System, a system that parallels to a degree that used by the USO. The only solution known prior was the use of a separate transmitter for each transformer and consequently a new frequency for each transmitter. The inavailability of the necessary frequencies and the problem of heterodyning made such a move impossible. Mr. Borst's method permits the coupling onto the 4000 volt line and the bypassing of the varied transformer allowing the use of but one transformer. Since some loss of power would be encountered in passing r-f through the transformers, which step down the 4000 volts to 110, it was found necessary to develop transmitters that would afford from 10 to 20 watts, and very well shielded. This step was taken in a newer type of unit,

At top, the circuit diagram of the 20-watt transmitter. At upper extreme left, the 6F6 is the oscillator, the next 6F6 is the buffer. The 6L6G's that follow are the class C amplifier. The phantom control is at lower left.

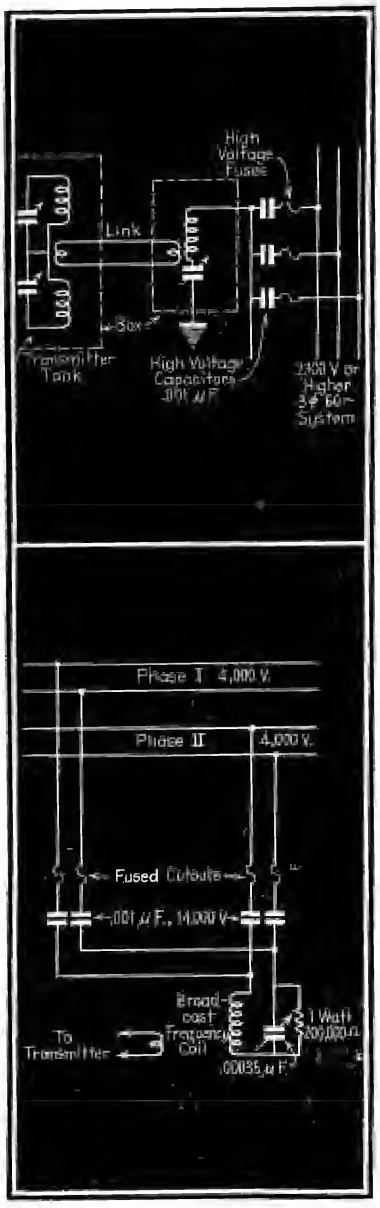
At the lower right appears another view of the transmitter. The line coupling coil is in the foreground.



that will be described later on.

Power Line Solutions

Since there is a transformer between the 23,000 volt incoming power line and the 4000 volt primary circuit, there is a chance that a little power will leak back into the high line, as well as the rest of the power system. This trouble is also curable by several methods, according to Mr. Borst. The power company can provide r-f chokes in either the primary or secondary leads to the 23,000/4000 volt transformer, which when properly tuned prevents the passage of r-f to the rest of the power system. If, however, it is impossible to secure such chokes of sufficient voltage and current rating, by-passing of each stepdown transformer with a capacitor from each primary line connection to each side of the secondary winding is the next solution. These condensers are of the .001 mfd. type with sufficient voltage rating. These are to be protected by high voltage low current fuses in series with each capacitor. This alternative allows a reduction of the r-f power fed into the 4000 volt circuit for a given amount of signal strength on the 110 volt circuits. This lessens the radiation from the 4000 volt lines and the leakage into the 23000 volt line. The method for coupling the transmitter to the 4000 volt line is shown below at left. The coil and condenser is designed to resonate at the frequency of the broadcasts. They are placed in a metal box together wtih a two or three turn link about the coil. The capacitors and the fuses are the same value as just described.



Condenser Substitutions

Since a high a-c voltage is built up across the small variable condenser in the coupling unit, some trouble is usually encountered. This is due to the fact that the variable condenser has a smaller capacity than the fixed coupling condenser. This high voltage causes the small variable condenser to break down and arc over. It is remedied by two methods. One entails the use of a variable condenser which has a voltage rating of approximately the same as the voltage of the system into which the r-f is fed, and the second covers the shunting of the variable condenser with a one watt resistor of about 200,000 ohms. This resistor does not upset the r-f characteristics of the coupling scheme. It reduces the amount of the 60 cycle voltage across the variable condenser and hence prevents it from arcing over.

The New Transmitter

The latest wired radio unit designed by Tom Rowland, engineer of the Radio Engineering Products division of Raymond Rosen affords an output of 20 watts as mentioned previously. High stability without the use of a crystal is afforded by an electron coupled oscillator with voltage regulation in the plate and screen supply. The oscillator and buffer coils are permeability tuned. This form of tuning is used because it aids the stability and makes the unit more compact. Any ordinary condenser, whether fixed or variable, would tend to increase the drift. In addition, in view of the high priorities on condensers and the materials used in them, the substitution will expedite construction.

Class C Amplifier Used

A class C amplifier with a single or parallel 6L6 is used as a quick method of changing power output considerably over a wide range. To use both tubes it is only necessary to change the bias resistor and plug the second tube in the socket.

Shunt Fed Plate Final

The plate of the final is shunt fed for several reasons. One is to keep the high voltage off the top of the chassis, since there will be many who are not too familiar with the operation of these transmitters, and thus may suffer from high voltages. The method also affords a method of cutting down the parts required. For it is possible with this system to use the final tank coil as the antenner coupling medium.

The audio amplifier is of conventional design. However the modulator uses the Heising choke method, with a class A modulator. This again is a move prompted by priority difficulties, for ordinarily class B transformers are used in modulator. Although the choke method hasn't been used lately, the quality afforded is actually better than class B, although the system is not as economical as the class B. However, since this is a low powered transmitter,

At left, top, appears the three-phase coupling circuit. At bottom, left, we have a two-phase coupler. At bottom right, Tom Rowland testing the experimental oscillator unit.

the power consumed is quite low anyhow.

The line amplifier to the studio is an RCA MI-12222 fifteen watt p-a amplifier. It feeds the leased telephone line through a 500 ohm matching transformer at approximately zero level. The input consists of two microphones and a phonograph turn-table.

A closeup of the line amplifier, having 15 watts of power. It feeds the leased telephone line through a 500-ohm matching transformer at approximately zero level.

The Phantom Circuit

The transmitter unit is remotely controlled from the studio by means of a phantom circuit on the telephone line. This circuit consists of two center tapped line matching transformers and a d-c power supply in series with a relay that closes the primary circuit to the transmitter. In the present model, the d-c is obtained from a rectifier filter.

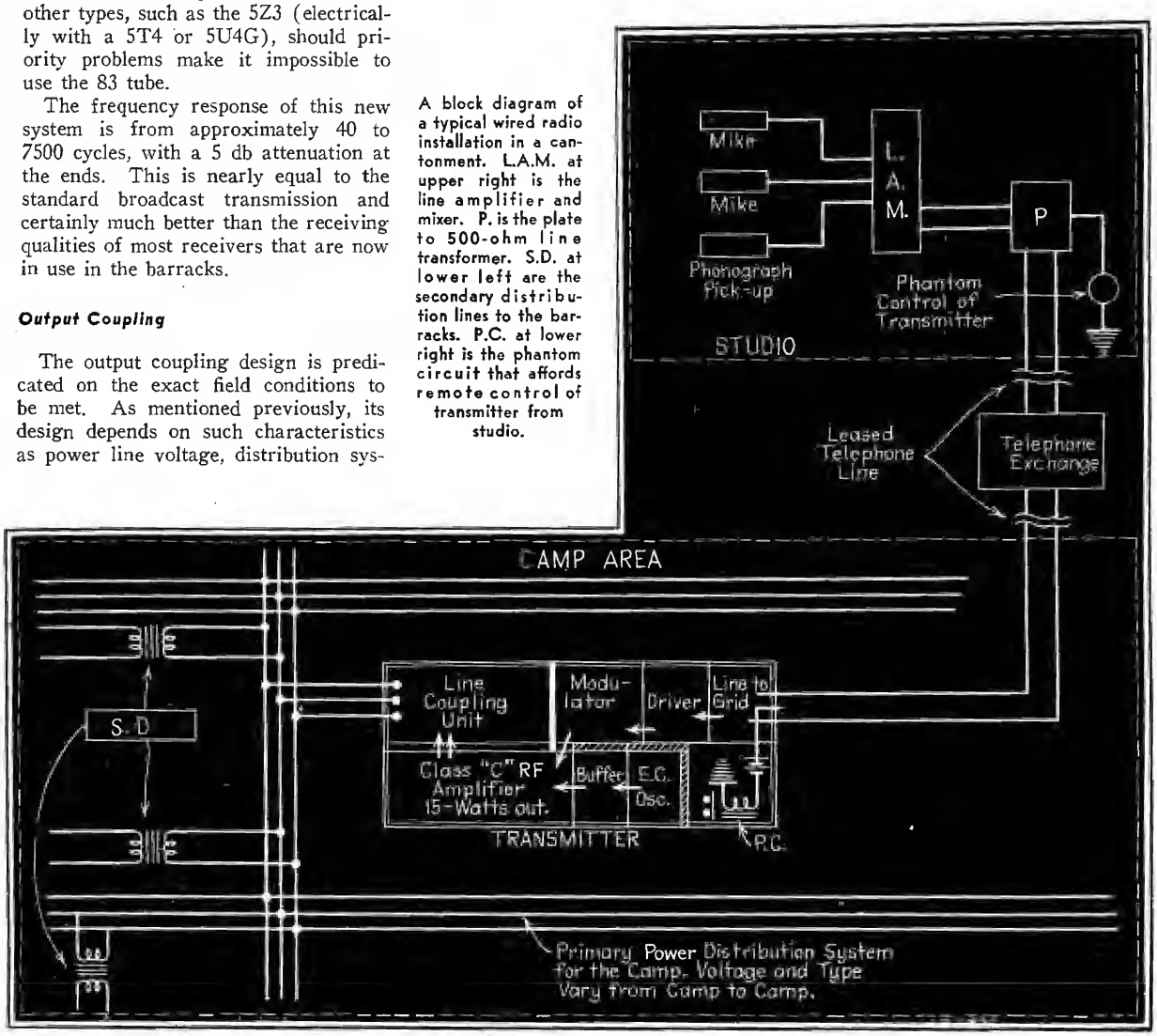
Interchangeable Rectifier Tubes

In the power supply, the 83 rectifier tube is interchangeable with several other types, such as the 5Z3 (electrically with a 5T4 or 5U4G), should priority problems make it impossible to use the 83 tube.

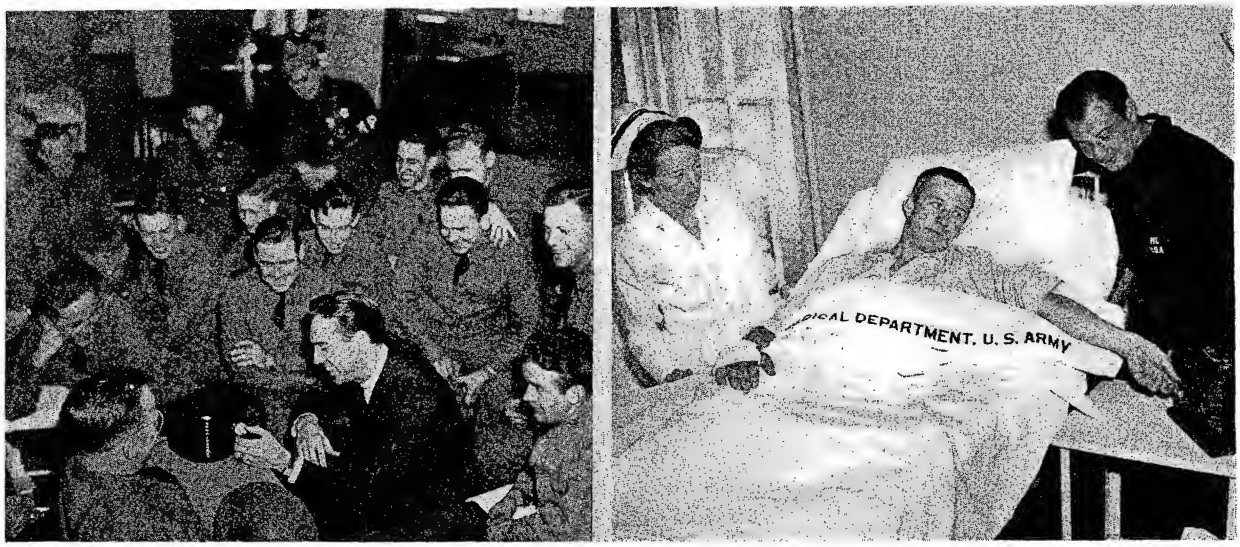
The frequency response of this new system is from approximately 40 to 7500 cycles, with a 5 db attenuation at the ends. This is nearly equal to the standard broadcast transmission and certainly much better than the receiving qualities of most receivers that are now in use in the barracks.

Output Coupling

The output coupling design is predicated on the exact field conditions to be met. As mentioned previously, its design depends on such characteristics as power line voltage, distribution sys-



A block diagram of a typical wired radio installation in a cantonment. L.A.M. at upper right is the line amplifier and mixer. P. is the plate to 500-ohm line transformer. S.D. at lower left are the secondary distribution lines to the barracks. P.C. at lower right is the phantom circuit that affords remote control of transmitter from studio.



Relaxation for everyone—thanks to wired radio. At left we have a typical listening session in the barracks, and at right we have a listening post in an infirmary.

tems (single, double or three phase), grounded or un-grounded conditions and line impedance to r-f. Incidentally in the cantonements, r-f can be fed into primary circuits of camp distribution systems, more readily than on college grounds where, notwithstanding, wired radio has been so successful. In the camps, the power circuit is usually independent of the town or city near or within the camp is located. Unfortunately, at most colleges, according to David Borst, dormitory and other student dwelling lighting circuits are not so effectively isolated from those of the college town. Thus care must be taken to restrict the r-f to college light wires only in many instances and thus only 220/110 volt circuits may be energized.

College Power System Methods

The college systems have, however, used methods of radiation that have possibilities for the camps too, where the power problems may become too complex. Some of the r-f transmission systems tried at colleges included a network of fine wires spread over the college campus to form a low power radio field to within a short distance of all student quarters, similar antennas connected by transmission lines with a master transmitter, transmission lines from a master transmitter feeding power into building radiator pipes and lighting circuits and audio transmission lines to remote transmitters covering one or more buildings each. The entire university owned power system as the transmission system has also been tried, using, in this instance, a master transmitter and the high voltage power lines. In addition, systems have used the secondary a-c lines of 220/110 to cover buildings tied to the same distribution transformer. At one college, twelve and thirteen dormitories are successfully covered by d-c mains, while at other colleges, the college owned power system is used. Usually, now, the most often recommended system is the secondary a-c lines fed either by student r-f lines powered by a master transmitter and/or in combination with remote transmitters fed either by phone lines or student erected lines and feeding one or more buildings within the vicinity.

The Red Division

In the red division of the network, recording at the studio is the featured activity. Both recordings made in the studio and by the blue mobile division are used here, for either entertainment or educational purposes when the wired system is not in operation or when the

(*Continued on page* 40)

Making of the paper disc records, on which photographed and written messages are printed. At left, we see the drying room, while at right, the cutting operation is shown

SUBSTITUTE MATERIAL

by E. A. LEACH
Radio Transmitter Engineering Department
General Electric Company

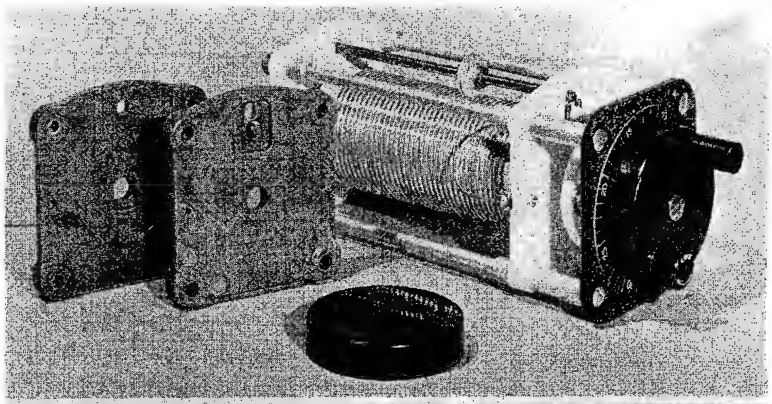
INDUSTRY is producing more and more of certain war items, the demands for which have created acute shortages of basic raw materials. As a typical example, the increased use of aluminum in aircraft and shipboard auxiliary apparatus has created an extremely grave situation which affects the use of this metal in military apparatus for all other applications. And the use of aluminum in military radio equipment for other than aircraft and combat vessel uses will not be allowed.

What can we do about it and how will we make the military radio equipment that the ground forces must have, minus aluminum? Some of the possible substitutes are brass, copper, zinc, wood and plastics. Copper and brass are scarce, zinc not quite as scarce, plastics reasonably available, and wood fairly plentiful. The engineer must recast his whole philosophy and adjust his methods of thinking to redesign on the basis of the abbreviated list of materials at his disposal. This is a challenge to inspire the free-thinker and may be the death knell for the unimaginative one.

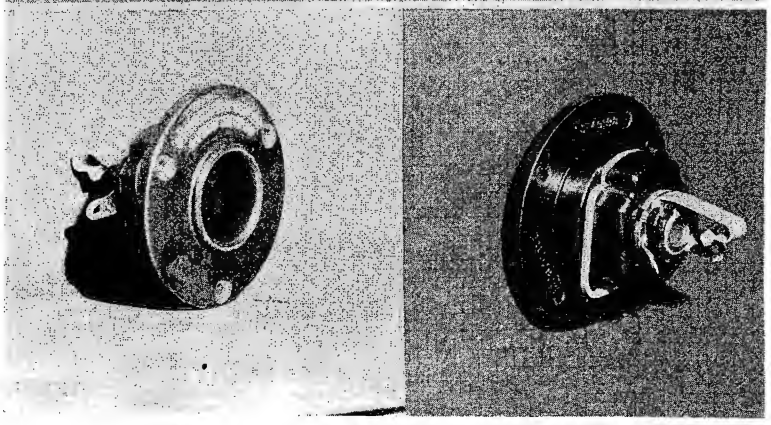
The case is not hopeless by any means. Here are a few examples of specific substitutions made in our apparatus, substitutions which have attained one or more of these objectives: (a) cut down the use of critical materials; (b) cut down the amount of labor needed to produce the part; and (c) reduced cost.

The first example is a small insulated mounting for a telephone jack; the substitution here accomplished all three of the objectives just mentioned. By the introduction of a molded plastic in place of a turned aluminum alloy part, the use of aluminum has been reduced. The plastics part itself comes out in nearly finished form; the only additional operation is to cut a small slot to hold the spring wire in position. The

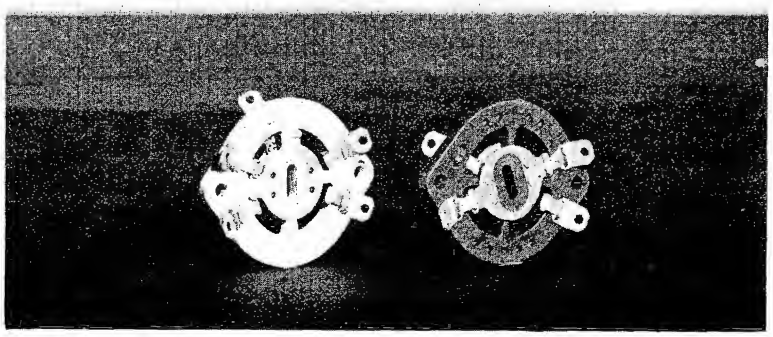
(*Continued on page* 41)



An antenna tuning inductor for radio transmitting equipment is shown at extreme right. At left and center are injection-molded mycalex supports and plastic housing to be substituted for similar steatite and metal parts.



A "substitute material" telephone jack (front oblique view, left), with small insulated mounting made of molded plastic in place of a turned aluminum alloy part. The telephone jack (rear oblique view, right).



Switch wafers made of Mycalex.

A Report on the

CLEVELAND IRE CONVENTION

by LEWIS WINNER
Editor

Highlights of Papers Presented by Hayes, Ouimet, Goetter, Belar, Fancher, Keister, Breeding, Scheldorf, Sinnett, Roys and Beers

HAYES' DISTORTION METER

WARTIME restrictions have prompted the development of many alternatives that have in most instances proven superior to the peacetime devices. This was most effectively illustrated by J. E. Hayes of the Canadian Broadcasting Corporation in his description of a new type of distortion meter. He pointed out that it was difficult to obtain suitable instruments without high priority ratings and those that were available were usually rather critical in adjustment or else could be used only on certain predetermined frequencies. Thus he developed an instrument that affords ease of operation, a minimum of controls, good stability, continuous frequency coverage and operation independent of any direct connection with the source of the test frequency.

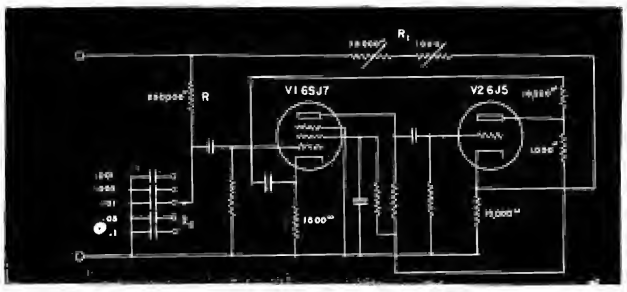
A practical circuit of electronic inductance was developed. It is a reactance circuit, as illustrated in Figure 2, requiring two tubes. A pentode affords the gain while the triode used as a cathode follower, maintains the proper phase relationship and gives the low output impedance necessary for low values of reactance, Mr. Hayes explained. Smooth control of the reactance is obtained by the variable resistor R_1. This changes the effective output impedance R_p of V_2. Continuing, Mr. Hayes said that the effective inductance of the circuit is changed in 3 to 1 steps by one section of a gang switch selecting any one of five-phase shifting condensers. Two other sections of the gang switch change the condensers in the bridge arms in similar steps, so that by providing a 10 to 1 range of R_p, and therefore of the effective inductance of the circuit, it is possible to balance the bridge at any frequency within its range of 30 to 10,000 cycles. Since, said Mr. Hayes, any one phase shifting condenser is used only over a three to one frequency range, if the circuit constants are adjusted to provide the optimum value of R/X_c at the middle of each range, the Q will still be reasonably good at either end of the range.

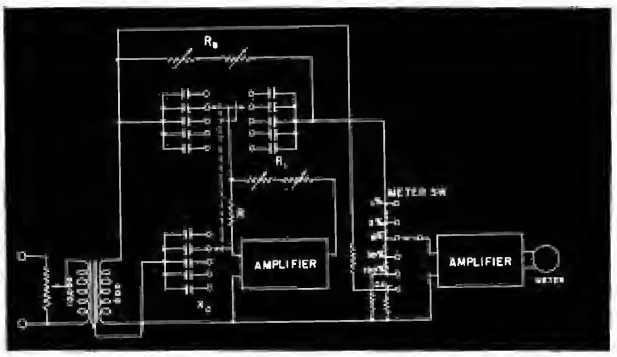
Figure 1
An experimental model of the distortion meter developed by J. E. Hayes

The addition of negative feedback stabilizes the gain of the tube, Mr. Hayes showed, and at the same time reduces noise and distortion.

Distortion Meter Circuit

In Figure 3, appears the circuit applied to the distortion meter. A gain of 44 is achieved in the amplifier section, while the maximum Q obtained is 3.3 for a ratio R/X_c of 6.7. While





Figures 2 and 3
In Figure 2, top, appears the electronic inductance circuit used in the Hayes instrument, the complete circuit of which appears in Figure 3, right.

Figures 4 and 5
In Figure 4, left, appears the military type van used by the CBC overseas for recording. In Figure 5, top, appears the interior of a portable type transmitting and recording van used by CBC.

this Q is somewhat lower than might seem desirable, Mr. Hayes pointed out that it is difficult to obtain a higher value without sacrificing some stability and increasing the complexity of the circuit.

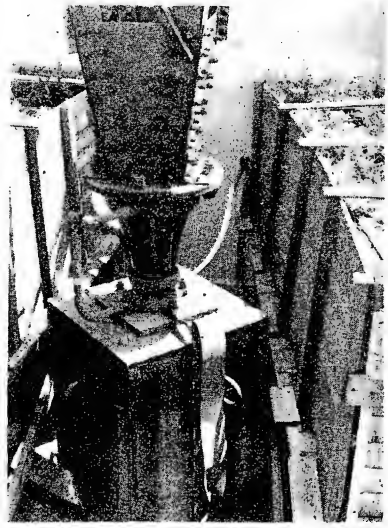
The Model Unit

A model of the distortion meter built is shown in Figure 1. It has the following controls . . . (1)—a "calibrate" knob to set the incoming test tone to the proper level . . . (2) a "frequency" control (R_1) and its associated range switch (the accuracy of the calibration is dependent on the tolerances of the fixed condenser of the bridge arms and elements determining the value of L_o) . . . (3)—the "balance-control" (R_B) which may be omitted from the front panel and ganged with the frequency control if desired . . . (4)—fine adjustments for the "frequency" and "balance-controls" . . . and (5) a meter-switch to provide the desired meter sensitivity.

Amplifier Explanation

In explaining the amplifier which precedes the meter, Mr. Hayes said that two 6 SJ7 pentodes and a 6J5 triode are used. Feedback is used across the two pentodes to stabilize the gain. The 6J5 is run at very low plate voltage so that its output cannot exceed a safe value for the meter. The meter is a standard oxide type VU meter with the addition of a special meter scale. It is coupled through a suitable series resistor and condenser to the plate of the 6J5 tube. Full scale deflection of the meter is obtained with about 0.5 millivolts at the input of the amplifier.

Although this application of an electronic reactance provides a good example of its flexibility, there are certain limitations inherent in a reactance circuit of this type, Mr. Hayes pointed out. These are . . . (1)—relatively low voltage circuit applications . . . (2)—drop of the Q of the circuit on either side of some optimum frequency. In addition, the amplifier portion must be designed with care so that phase shifts introduced by it do not cause the circuit to break into oscillation.



Figures 6 and 7
Figure 6, extreme top, vertical radiator protection at CBC. Figure 7, above, CBC building protection.

WARTIME MAINTENANCE IN CANADA

THE wartime problems facing the broadcast stations in Canada are numerous. Many are identical to those we have here in this country and many are, of course, applicable only to those in Canada, in view of the unusual terrain and coverages required. In explaining these problems, J. A. Ouimet, assistant chief engineer of the Canadian Broadcasting Corporation, said that the CBC has 10,000 miles of transmission lines operating through five time zones, extending from Sydney, N.S., to Vancouver, B.C., and linking a total of 57 stations. Of these, 36 are basic outlets, and 21 are supplementary, with 47 privately owned and 10 owned and operated by the CBC. Four of these are 50 kw outfits. In addition there are stations of either 5 kw or 1 kw power as well as three shortwave stations. The CBC stations represent 71% of the total power of all Canadian stations, said Mr. Ouimet, and cover 85.5% of all Canadian homes. To produce programs for this network, there are studios at points from coast to coast. This is further supplemented by international exchanges with American networks and the BBC, with programs from the CBC overseas mobile unit and the BBC being received at a four channel shortwave diversity receiving station. To man these facilities, a staff of more than 150 is maintained, exclusive of the engineering personnel.

Many precautions have been taken to protect vital parts, said Mr. Ouimet.

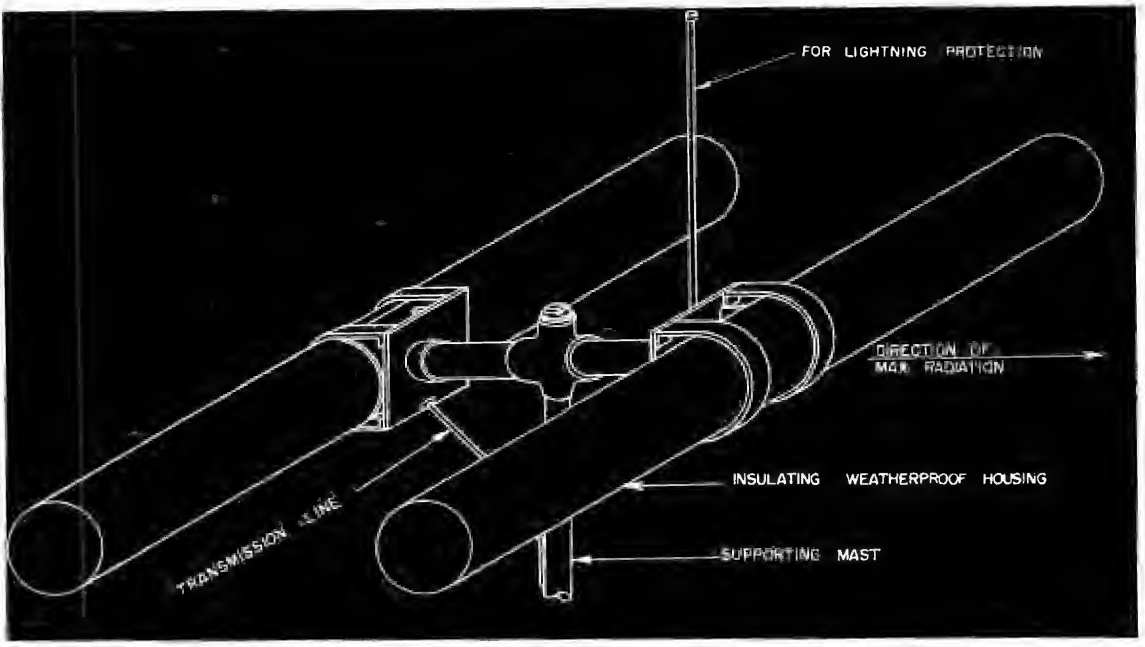


Figure 8
The special f-m relay antenna, discussed by W. F. Goetter, which features two horizontally polarized co-linear arrays, spaced three-quarters of a wavelength apart and fed in the proper phase to provide maximum radiation in the desired direction.

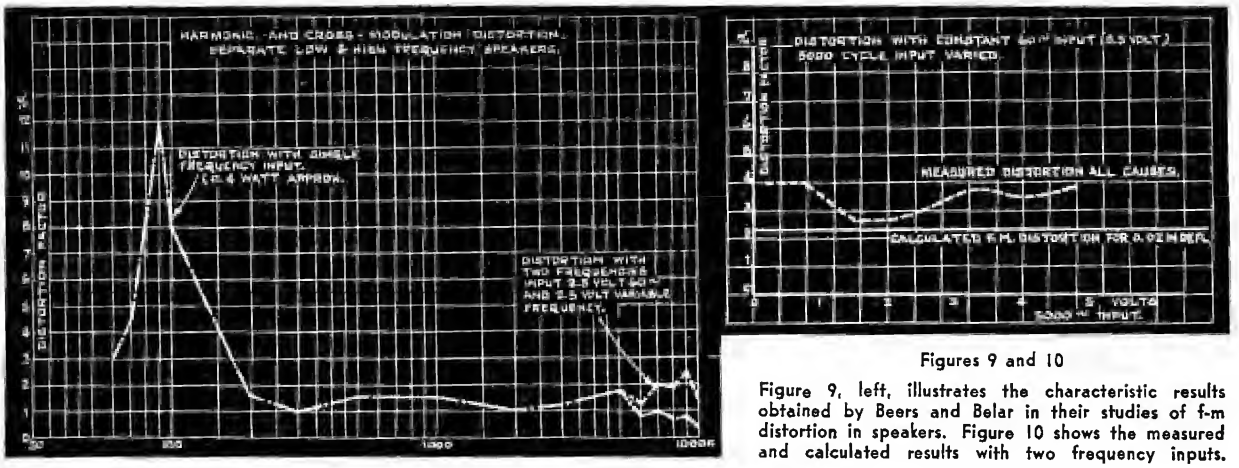
For instance, to prevent destruction by explosive projectiles, sand barricades around guy anchors and at the base insulator of all vertical radiators, have been erected (Figure 6). The same precaution was also taken for outside power substations, as well as in front of certain sections of transmitter buildings, such as the large glass brick section of the transmitter shown in Figure 7. The sand bags are not used in this latter case. Instead, loose sand between wooden supports is used. This construction is in sections so that damage to one part of the structure will not cause all of the sand to pour out, rendering the whole barricade useless, explained Mr. Ouimet. In addition, it was learned that sand bags were not suited to long exposure to Canadian climatic conditions.

Protection against sabotage is, of course, only a small part of the measures that the Canadian broadcasters have had to take. The shortage of equipment and difficulties of procurement is just as serious as in this country, said Mr. Ouimet, and perhaps even more so, since practically all of the major radio parts and transmitter tubes used in Canada have to be purchased from America. A drive to conservation of equipment is thus most essential. The backbone of such a drive is a sort of a war emergency manual, which is distributed to all who handle equipment.

Another feature of the drive, explained Mr. Ouimet, is the maintenance of an accurate inventory of all CBC facilities, spare parts, expendables, and even of so-called "junk piles." With the number of plants operated by the CBC, this is an equivalent of pooling of equipment, such as is being planned in America, said Mr. Ouimet. Under this plan, the spares of any one of the CBC stations can be shipped at a moment's notice to any other CBC plant which may be in difficulty.

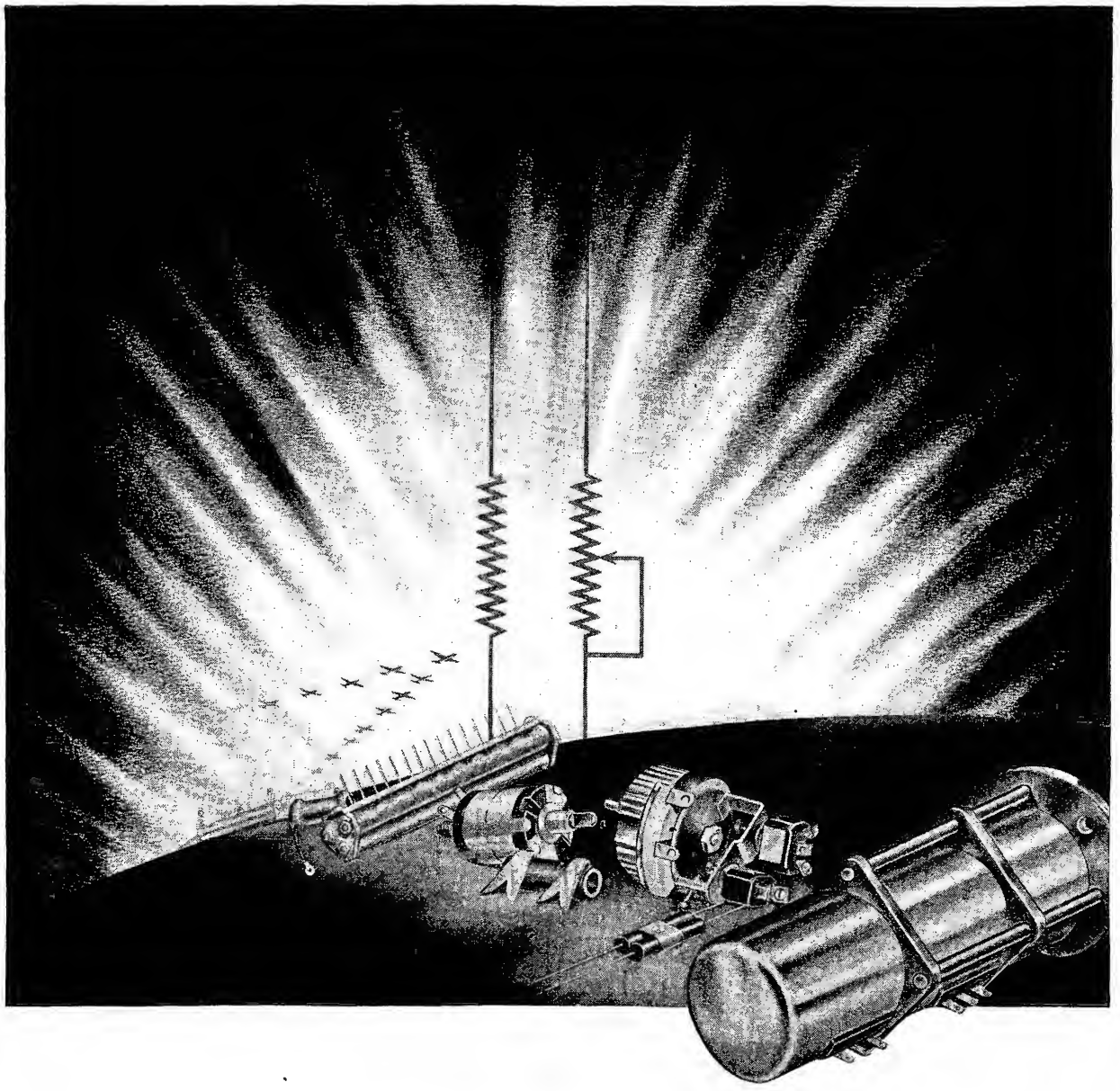
Perhaps the most vital contribution broadcasting could make towards conservation of tubes and equipment, said Mr. Ouimet, would be to actually reduce the power output of broadcast stations. A 20% power reduction might double the life of tubes and yet hardly effect the service to the listener. The CBC engineers are convinced of the advisability of this measure, explained Mr. Ouimet, and thus have already taken steps towards its application in recommending its adoption to the Canadian Radio Administration.

To meet the possibility of destruction of regular antennae, emergency aerials are being installed at all transmitters, said Mr. Ouimet. The CBC engineers have found that a simple structure of the L or T type with 80 foot masts is adequate. On a frequency of 1070 kc, calculations have given a field strength of 158 mv/kw at a mile. This is sufficient for emergency operation, explained Mr. Ouimet. Such an



Figures 9 and 10

Figure 9, left, illustrates the characteristic results obtained by Beers and Belar in their studies of f-m distortion in speakers. Figure 10 shows the measured and calculated results with two frequency inputs.



TOMORROW'S RESISTORS

The war has not stopped IRC engineering and development work. It has only intensified it. One exacting requirement after another has been met. New requirements will be met as they arise.

Thus, just as IRC has pioneered the most important fixed and variable resistor developments of the past two decades, you can look to IRC for continued leadership, both in resistor development and in the all-important "Know-how" of resistor application and use under all conditions and in all parts of the world.

Tomorrow's resistors are being born in today's crucible of War—and, as in the past, they will bear the trademark "IRC."

INTERNATIONAL RESISTANCE COMPANY, 415 N. BROAD ST., PHILA., PA.

Figure 11
The Schenectady studio of the television system described by H. B. Fancher.
(See page 20.)

antenna costs only $1,000 complete, whereas a similar structure with masts 150 feet high which would give only 15% more radiation, would cost $2,000. By placing the antenna close to the transmitter building, the question of the emergency transmission line offers no problem, said Mr. Ouimet.

Another wartime precautionary measure is the adoption of low power standby transmitters. These standby transmitters have been assembled from old units which were taken out of service. These units are arranged for operation on either one of the frequencies of the two main transmitters as well as on medium shortwave, to be used also as a studio transmitter link, in case of the failure of the studio transmitter lines, explained Mr. Ouimet.

Portable equipment and mobile units also contribute to the wartime measures taken in Canada. A trailer and car combination contains its own power plant, two recording channels, two 40-watt transmitters for medium shortwave and u-h-f, with a push button master control position and necessary a-f equipment for simultaneous broadcasting of two separate feeds. One special unit, now in use in England, uses a specially built military van, designed to meet actual war conditions. It has been overseas now for more than two years and has seen actual war service during the height ot the blitz.

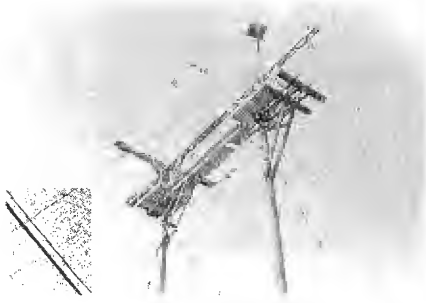
F-M IN S-T RELAY SYSTEMS

THE inherent properties of f-m have prompted the development of a new and important phase of transmission from studio to the transmitter, by way of studio-transmitter (S-T) circuits. Among those who have pioneered in the design and production of equipment needed to link these circuits effectively has been General Electric. Their latest apparatus, including a transmitter-receiver and associated components, was analyzed by W. F. Goetter, who said that S-T equipment offers a vital means of relaying high fidelity programs from studio to the main transmitter.

Included in the system is a 25 watt transmitter, that employs the principle of direct frequency-modulation of an oscillator having its mean frequency stabilized by a crystal. In this unit, the sixth harmonic of the modulated oscillator and the sixth harmonic of a temperature controlled, highly stable crystal oscillator, are combined to produce an intermediate frequency of 3 mc, said Mr. Goetter. The third harmonic of the modulated oscillator is combined with the twenty-fourth harmonic of the same crystal oscillator used for the frequency control circuit. These two frequencies, when added together, produce a signal which when tripled, said Mr. Goetter, becomes the transmitter output frequency.

In the final tripler and output stages new type tubes, GL-8010A-R, are used. Their construction is such that the elements are effectively co-planar, making efficient operation possible at u-h-f. The plate dissipation is 50 watts.

The receiver is a crystal controlled, double conversion super-heterodyne, featuring cascade limiting and carrier-off-noise-suppression. When operating over the band of 260 to 300 mc, the eighteenth harmonic of the crystal is



Figures 12 and 13
Figure 12, left, television receiving antennas for video and aural reception. Figure 13, right, the visual monitor rack. (See page 20.)

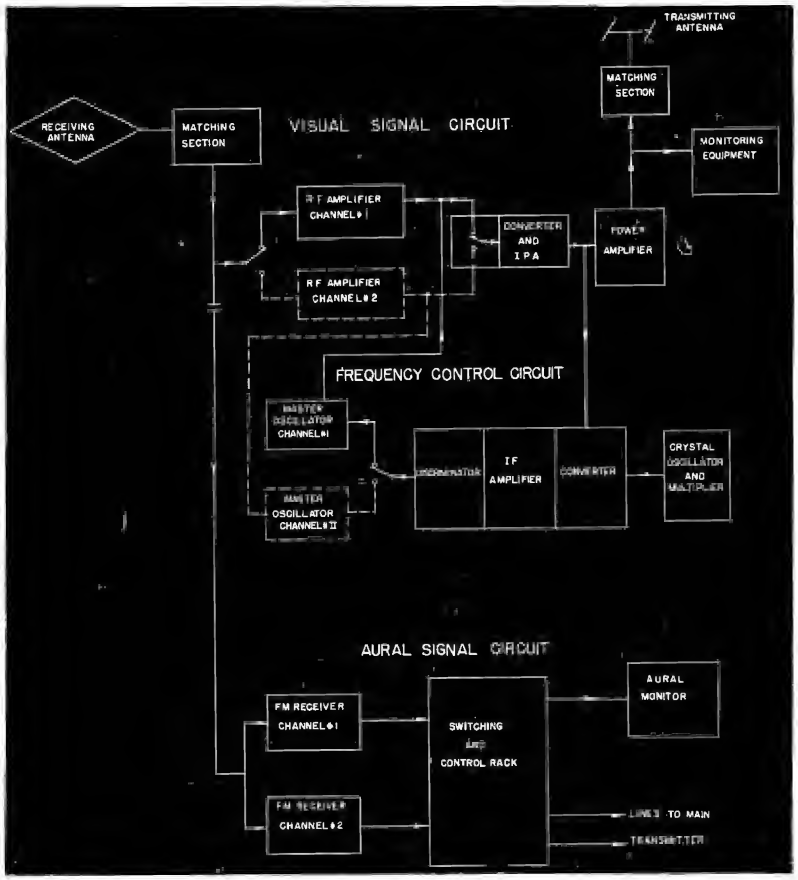


Figure 14
Block diagram of the television relay system described by J. E. Keister. (See page 34.)

used for the first conversion in this receiver, while the second harmonic is used for second harmonic. Over the range of 300-350 mc, the sixteenth harmonic is used for the first conversion and the second harmonic for the second conversion. In the h-f stages, acorn type tubes are used. These circuits are linear tuned. Coarse frequency adjustment is accomplished by movable short bars and vernier adjustments may be made with small trimmer capacitors, said Mr. Goetter. The audio channels, of which there are two, one for program and one for monitoring, use resistance-capacitance de-emphasis circuits. This maintains the frequency receiver response within .5 db of the desired de-emphasis standard from 30 to 16,000 cycles.

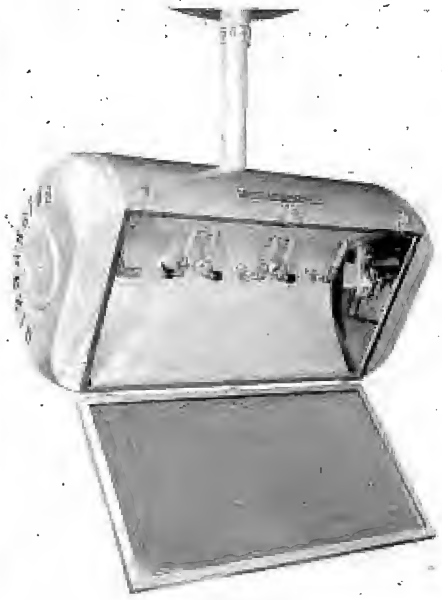
The antenna, an important component in the link, has a number of new and unusual features, in addition to those required by FCC regulations. It consists of two horizontally polarized co-linear arrays spaced three-quarters of a wavelength apart, and fed in the proper phase to provide maximum radiation in the desired direction. Each co-linear array consists of five half-wave radiating elements connected by phase inverting elements. Power is fed to each array through a matching section at the midpoint of the center radiating elements. All radiating elements, phase inverters and matching sections are completely enclosed with Herkolite insulating tubing. This tubing, said Mr. Goetter, is air-tight and connected so that the entire antenna as well as the transmission line may be pressurized, if desired. In addition, this enclosure protects the antenna against sleet and ice-melting.

Another major unit in the S-T system is the station monitor, which measures . . . (1)—mean frequency carrier with and without modulation . . . (2)—percentage of f-m modulation with (3)—alarm indication for over-modulation and (4)—fidelity of the modulated signal.

LOUDSPEAKERS AND F-M DISTORTION

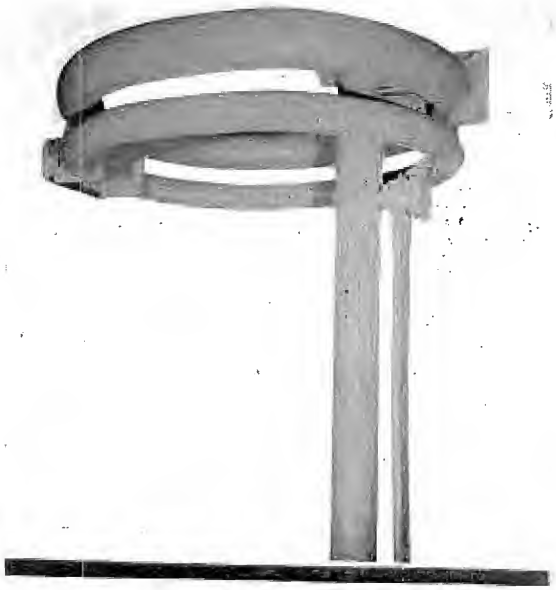
HIGH fidelity response, and distortion in loudspeakers have been the subject of research of many for years. The importance of

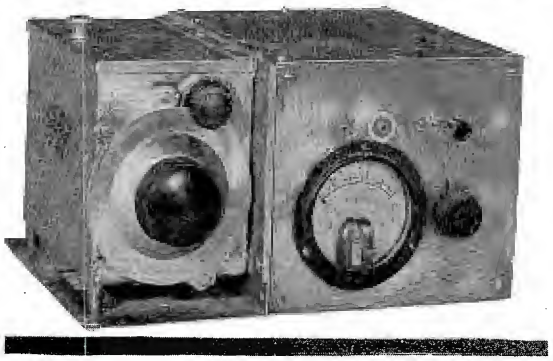
(*Continued on page* 20)



Figures 15-16

Figure 15 illustrates a typical television studio at Schenectady using the new G.E. water-cooled mercury lamps discussed by H. A. Breeding. At right, Figure 16, appears a close-up of one of the Luminaires used in the studio. (See page 36.)





Figures 17, 18 and 19

Figure 17 illustrates the new circular antenna developed by M. W. Scheldorf and L. M. Leeds of G.E. Figure 18, center, the special unit for measurements of antenna, transmission line, etc. Figure 19, a four-bay circular antenna system. (See page 36.)

THE CLEVELAND IRE CONVENTION

(*Continued from page* 18)

minimizing distortion in a high fidelity system having become more pertinent with the advent of f-m. Recently in a review of the distortion problem, a mathematical and experimental investigation of the possibility of f-m distortion in loud-speakers was conducted by G. L. Beers and H. Belar of the RCA Manufacturing Company, Camden, N. J. The results of this investigation were presented by Mr. Beers, who pointed out that the mathematical analysis and measurements prepared, indicated the possibility of f-m distortion in speakers, when reproducing a complex sound wave. Its effects are most pronounced in high fidelity systems, since this distortion increases with frequency.

In discussing the tests made Mr. Beer said that the amplitude of the cone motion of a loud speaker required to radiate a given acoustic power varies inversely with the square of the frequency and inversely with the square of the diameter of the speaker cone. The amplitude of the cone motion is likewise proportional to the square root of the a-f power supplied to the speaker, Mr. Beers continued. Thus, a 12 inch cone working with both sides, in air requires a motion through a peak amplitude of 1/16″ . . . each side of its mean position . . . to radiate one acoustic watt at 100 cycles. Accordingly, said Mr. Beers, a 12 inch cone radiating one acoustic watt at 100 cycles simultaneously with a 5,000 cycle signal will distort the 5,000 signal by approximately 10% due to f-m. An eight inch cone could only radiate .21 watt at 100 cycles for the same distortion at 5,000 watts and only 0.013 watt at 50 cycles for the same distortion limit, continued Mr. Beers.

In computing the f-m distortion for the measured amplitude of cone displacement on a 12-inch cone speaker, it was found that at 5,000 cycles, and above, f-m distortion began to have an effect, the calculated amount being 4% at 6,000 cycles. This was predicated of course on a dead auditorium. In a live room, the f-m of an audio wave becomes more noticeable. In such a room, explained Mr. Beers, the pattern of standing waves is continuously shifted, and thus small changes in phase can produce large changes in amplitude, thereby converting f-m into a-m.

To test the distortion of the measuring channel distortion, measurements were made with a distortion meter connected directly across the voice coil of the speaker, said Mr. Beers. This distortion always measured less than 1%. But this did not preclude the possibility of distortion in the microphone, explained Mr. Beers. The latter is usually assumed to have very low distortion, which was further verified by tests on a combination speaker which used a separate high and low frequency unit, and which should have very low cross modulation and f-m distortion. In Figure 9 appears measurement data that confirmed this conclusion.

Continuing his explanation of the tests, Mr. Beers said that f-m distortion should be independent of the amplitude of the modulated frequency, but be directly proportional to the amplitude of the modulating frequency. Thus, if 5,000 cycles and 60 cycles are reproduced together the percent distortion of the 5,000 cycles wave due to f-m should be independent of the amplitude at 5,000 cycles, but should be directly proportional to the amplitude of motion at 60 cycles, a confirmation of which appears in Figure 10. Here we see the distortion for a constant 60 cycle input but with the amplitude of the 5,000 cycle signal varied. The percent distortion should remain constant, according to calculations, and the measurements confirmed this conclusion, said Mr. Beers.

To reduce f-m distortion in complex cones, Mr. Beers offered four methods . . . (1) reduce the amplitude of the cone traverse by loading the speaker with a horn . . . (2) increase the cone diameter and thus reduce amplitude of motion . . . (3)—limit the power input at low frequencies . . . and (4)—use separate speakers for the low and high frequencies.

TELEVISION TRANSMISSION ON HIGH POWER

THE transmission of video waves on high power has been carried on successfully from the 1,200 foot high Helderberg mountain transmission point for some time now via a 40 kilowatt visual transmitter. A thorough description of this unusual transmitter . . . WRGB . . . was the basis of a discussion by H. B. Fancher of the General Electric Company.

The visual transmitter system employs low-level modulation, said Mr. Fancher. This means that all stages from the modulated stages to the final output stage must be linear and pass without attenuation frequencies from 0.75 mc below the carrier to 4 mc above. While operating from the Schenectady studio, the signal passes

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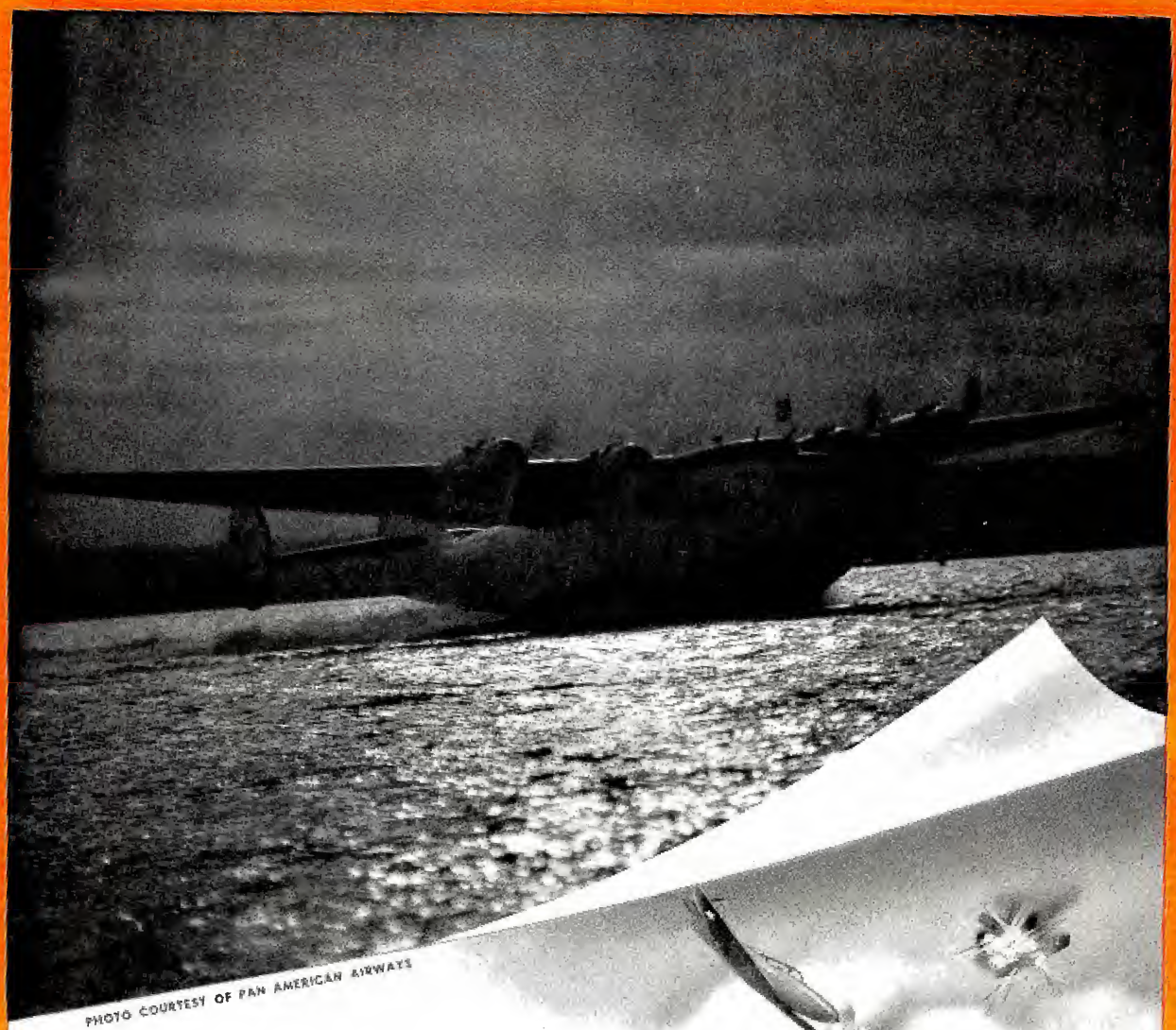

PHOTO COURTESY OF PAN AMERICAN AIRWAYS

In PEACE . . . as in WAR

Two-way radio communication is a vital factor whose importance is magnified by today's events around the globe. Not only do our far-reaching fighting forces coordinate their operations through the maintenance of radio communication—but we, at home, are supplied with constant information concerning their activities.

Tomorrow, when the nations will again be at peace, giant transports will link the peoples of the world closer and closer . . . and two-way radio communication will cement new ties with all peoples, everywhere.

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BUY WAR BONDS AND STAMPS

NEWS BRIEFS OF THE MONTH...—

COLIN B. KENNEDY DEAD

Colin B. Kennedy, one of radio's pioneers, died recently.

Colin Kennedy, in 1921, headed the radio company bearing his name with St. Louis as its headquarters. He was one of the first holders of a license to manufacture home radio under Armstrong patents.

Colin Kennedy, when he died, was doing his stint for his country as an OPM engineer assigned as civilian advisor to the Army Signal Corps.

* * *

BENWOOD LINZE TAKES OVER FORE ELECTRIC

The Benwood Linze Co., St. Louis, Mo., designers, engineers and manufacturers of electrical rectifiers and rectifier-transformer assemblies, has purchased the Fore Electric Co., located at 4800 Delmar Blvd., St. Louis, Mo. The purchase includes all of the company's equipment, inventory, assets and trade name. All facilities have been moved to the plant of the Benwood Linze Co., at 1815 Locust Street.

The Fore Electric Co. was founded in 1917 under the direction of Albert Wehmeier, and manufactured battery chargers of both vibrator and bulb type, magnetizers, transformers and electrical meters.

* * *

AUDIO DEVICES RECEIVES NEW PATENT

An improved sound-recording blank with a non-punchable base material having an inserted punchable center is now covered by Patent No. 2,283,797, issued on May 19th to Audio Devices, Inc., New York City, makers of glassbase "AUDIO-DISCS."

* * *

JEFFERSON-TRAVIS OPENS WASHINGTON OFFICE

The Jefferson-Travis Radio Mfg. Corp. announces the opening of a branch office in Washington, D. C. F. Lee Hardesty will be in charge of the new office, located at 1026 17th Street, N. W. Mr. Hardesty has resigned his position in the radio procurement division of the British Air Commission to accept this new post.

* * *

W75NY RECEIVES ITS F-M TRANSMITTER

New York City's newest f-m station, W75NY, to be operated by Metropolitan Television, Inc., has received its G. E. f-m transmitter. The station is the seventh in the New York area and is owned jointly by Bloomingdale's and Abraham & Straus department stores.

Construction of the station, atop the Hotel Pierre, was begun in mid-March under the direction of Louis Thompson, who has been placed in charge of the station.

The FCC assigned a Class B f-m permit for the use of 47.5 mc. to Metropolitan Television, Inc., last year.

* * *

SYLVANIA ENGINEER WINS COMMISSION

Ralph S. Merkle, commercial engineer for Hygrade Sylvania and technical editor of Sylvania News, was commissioned First Lieutenant in the Coordination Branch of the U. S. Army Signal Corps. He has been stationed in Washington, D. C.

NEW SHURE BOOKLETS, CATALOGS

A 16-page booklet entitled "Long Live Your Microphone" and a new 8-page catalog have just been published by Shure Brothers, 215 West Huron Street, Chicago.

The booklet is an important contribution to the War Conservation Plan, telling in story and picture "how to get the best service from your microphone." There are helpful hints on the use and care of crystal, dynamic, and carbon microphones . . . practical pointers on feedback, cable, plugs, output, response, and other valuable information.

All the material and data are based on actual statistics from the Shure Service Department.

In the new catalog appears the new Shure line, which has been simplified to meet today's problems. Technical data are given on Shure dynamic, crystal, and carbon microphones for use in Ordnance Plants, Army Camps, Air Terminals, Broadcast Stations, Police Mobile and Station Transmitting Equipment, Industrial War Factories, OCD Control Centers, and all other important microphone applications.

An interesting story also tells how microphones are accurately measured.

Copies of the booklet or catalog are available free.

TECHNICAL G.E. RECEIVING TUBE MANUAL

A 24-page technical manual on G.E. radio receiving tubes, prepared to assist those who work or experiment with radio tubes and circuits, has been released by the Renewal Tube Sales Section of the General Electric Radio Television and Electronics Dept., Bridgeport, Conn. The manual can be obtained by radio service men, radio technicians, experimenters, radio amateurs, and others technically interested in radio tubes by writing the G.E. department.

* * *

OHMITE'S STREAMLINED CATALOG

A streamlined 16-page edition catalog has just been released by the Ohmite Manufacturing Company, 4885 Flournoy Street, Chicago, Ill.

Appearing are data on rheostats, adjustable resistors, fixed resistors, antenna resistors, tapped resistors, switches, attenuators, chokes, dials, suppressors, etc.

Write for your copy.

WARTIME CONDENSER CATALOG

This is war is the keynote of the new 1942 Aerovox Catalog just off the press. The catalog lists those essential condensers, resistors and test instruments in popular demand and therefore still produced, stocked and available for prompt delivery. A further wartime note is the inclusion of several pages of motor-starting replacement capacitor listings, in acknowledgment of widespread and growing demand for refrigerator maintenance. A copy of this catalog may be had by addressing Aerovox Corporation, New Bedford, Mass., or through the local Aerovox jobber.

* * *

PHOTOELECTRIC CELL BULLETIN

A 10-page bulletin with technical data on electrical characteristics of the blocking layer photoelectric cells, has been released by Embry Products Co., 1800 W. Pico Blvd., Los Angeles, Calif.

Ten charts and curves, tables showing various types of active surfaces, etc., are also included.

* * *

NEW MORSE CODE PRACTICE

A new course in Morse Code practice has been inaugurated over the Dartmouth Broadcasting System for the benefit of Dartmouth undergraduates enrolled in Civilian Pilot Training and the Naval Reserve or looking forward to possible enlistment in the Signal Corps and similar branches of the Army. The course is being sponsored by Dean Frank W. Garran of Thayer School of Engineering, coordinator of the college's Civilian Pilot Training program.

The Dartmouth course is designed for beginners. Code practice is given over DBS five nights a week for 45 minutes each night and will gradually work up to approximately 15 words a minute. Thirteen words a minute qualifies for an amateur's certificate, to which importance is attached by both the Army and Navy.

Code is broadcast by means of records and an audio-oscillator, both of which are available at the DBS studio to interested students who wish to supplement the regular practice over the campus airwaves.

* * *

R.C.P. INSTRUMENT CATALOG

New RCP instruments for laboratory and production in wartime applications are described in the latest Radio City Products bulletin No. 126.

Typical of these new RCP models is a sensitive Electronic Limit Bridge for precision resistance testing, and a highly versatile multitester for quick and accurate production line tests.

Copy of catalog will be sent on request. Inquiries should be addressed to the Engineering Department, Radio City Products Co., Inc., 127 West 26th St., New York City.

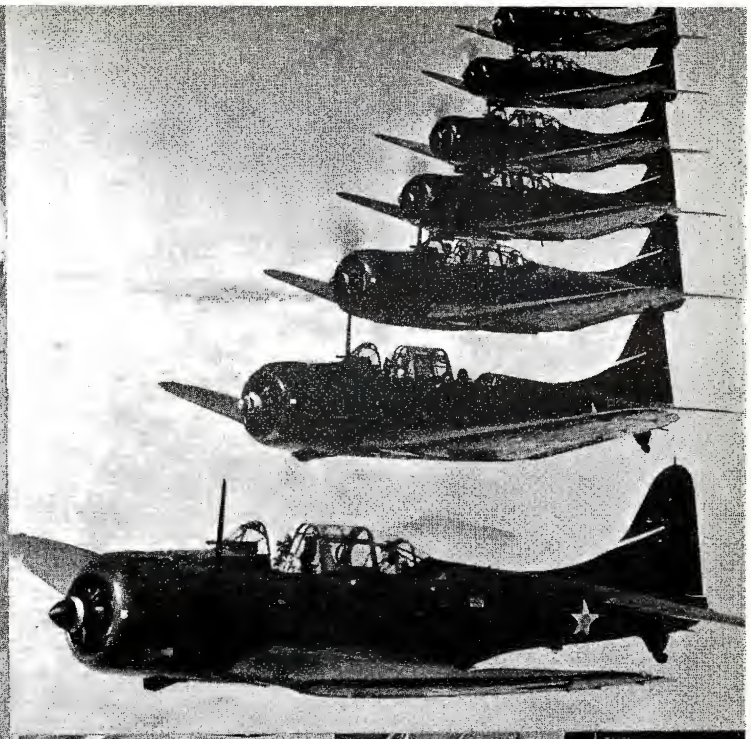
* * *

SWITCHBOARD INSTRUMENT CATALOG

Direct current and alternating current indicating instruments for mounting on switchboards are described in a new 12-page catalog published by the Roller-Smith Company, Bethlehem, Pennsylvania.

These instruments include d-c ammeters

(*Continued on page* 32)



U. S. NAVY OFFICIAL PHOTOS

UTC CASE HISTORIES

Laboratory File No. S14-523	Laboratory File No. S14-312	Laboratory File No. T16-399	Laboratory File No. S9-474
SORRY, NO PHOTO	SORRY, NO PHOTO	SORRY, NO PHOTO	SORRY, NO PHOTO
This unit helps "keep them flying." A UTC redesign combined two units in one . . . reduced quantity of critical materials 50% . . . reduced weight and size 40% . . . reduced installation time 60% . . . reduced possible trouble points 50%.	This unit maintains ground communications at a more efficient level. Now plastic housed. Critical materials reduced 50%. UTC design reduced possible trouble points 50% . . . reduced difficulty of operation 50%.	This unit is used at a number of points in aircraft communication. A UTC design reduced quantity of critical materials used 20% . . . reduced weight and size 20% . . . reduced possible trouble points 50%.	This unit is a component in a piece of aircraft equipment. A UTC design reduced quantity of critical materials 60% . . . reduced weight and size 60% . . . made possible a similar reduction of size and weight in the complete equipment of which it is a component.

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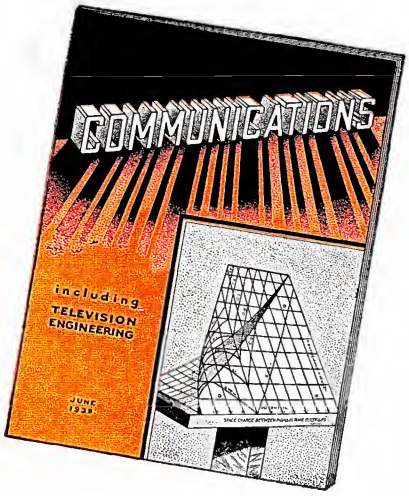

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THE APCO CONFERENCE

POLICE radio has entered one of its most important phases since inception, for today, it wields its mighty power in the National all-out wartime schedule. In this role, police radio assumes new roles, measures, and new methods that demand unusual attention. The discussion of these and other allied problems will thus be featured at the 9th Annual APCO Conference at St. Louis, Missouri, by such personalities as Herbert DuVal, Daniel Noble, R. M. Ellis, M. A. Wilt, Capt. Donald S. Leonard, William J. McDonnell, G. E. Nielsen and G. B. Norris.

DuVal and F-M

Mr. DuVal of General Electric, known for his f-m engineering activities, will point out the many features that f-m has to offer in emergency work, particularly under handicap conditions. Methods of design, involving substituted materials that afford improved results will be analyzed.

Dr. Noble's Talk

Daniel Noble, another recognized f-m authority will bring to the conference another of his lucid discussions covering the properties of f-m and their usefulness in police radio. It was Dr. Noble, who prompted the development of such outstanding police radio systems as the New Hampshire State Police system, the Connecticut system and the Michigan system. In the New Hampshire system, many unusual features were incorporated, features that are "musts" in emergency work today. For instance, the low noise level pickup point method was installed with great effectiveness. This pickup point is atop a 1000 foot mountain, with the receiver mounted in a waterproof box attached to a telephone pole and the antenna mounted at the top of the pole. The output of this receiver is carried over the telephone wires to police headquarters six miles from the pickup point. A second low noise pickup point is provided by an automatic ultra high frequency relay unit, installed atop Mt. Kearsage. Transmission from the mobile units is received by a receiver which includes a relay in the squelch system. The received signal automatically turns on a 118 mc transmitter and the output of the receiver modulates the transmitter, so that the message is relayed to police headquarters at a point 22 miles away from the transmitter.

The Program

Monday, July 27th, 1942

9:00 A.M.—Registration
10:00 A.M.—Conference opened by president M. A. Wilt
2:00 P.M.—Address by Capt. Donald S. Leonard, President, I.A.C.P.
Demonstration by Bell Telephone Company Engineers

Tuesday, July 28th, 1942

10:00 A.M.—Meeting called to order
Address by William J. Davis, Asst. Mgr., A. P. & I. B.
11:00 A.M.—Address by G. B. Norris, Special Agt. in Charge, F.B.I., St. Louis
2:00 P.M.—Address by Frazier Hunt, former war correspondent, at present commentator on the G. E. news broadcasts
Address by Herbert DuVal, Jr., General Electric Company

Wednesday, July 29th, 1942

10:00 A.M.—Meeting called to order.
Informal discussion with R. M. Ellis, P. R. Mallory Co.
Address by R. G. McCurdy, Western Electric Div., Graybar Electric Co.
Address by O. S. McDaniel, Southwestern Bell Telephone Co.
2:00 P.M.—Address by Prof. Daniel E. Noble, Galvin Mfg. Corp.
Address by William J. McDonnell, Inspector in Charge, F.C.C.
Address by G. E. Nielson, Engineering Dept., F. C. C.

Thursday, July 30th, 1942

10:00 A.M.—Meeting called to order.
Demonstration and discussion with William J. Davis and Associates, A.P. & I. B.
Election of officers
2:00 P.M.—Installation of officers
Committee appointments

Nielsen and the FCC

G. E. Nielsen of the FCC Engineering Department will analyze the recent rules and requirements of the Federal Communications Commission, which apply to the operation of radio stations during the war.

Ray Ellis' Talk

Highlighting the talk by R. M. Ellis of P. R. Mallory will be a discussion of vibrators . . . . their design, construction, need in police radio, and servicing and maintenance.

Telephone Company Data

Representatives of the telephone companies will point out the uses to which they have put emergency forms of radio on both the a-m and f-m types of trasmission. Methods used to link their activities with those of the local police units will be analyzed. This method of cooperation, incidentally, is being practiced widely. In many instances, the agencies used to guard properties are given local police authority and operate with the police departments, as well as independently.

Manpower Discussion

Manpower problems will be another pertinent subject that will have the limelight of discussion. Although all efforts have been made to retain those officers who man the radio equipment in the cars as well in the stations, their importance to the armed forces have been stressed by many. Accordingly, quite a few have been inducted. However, with the efforts of the new manpower commission in full swing, undoubtedly, most of these specialists will be deferred and be allowed to remain at their posts.

Other topics that will be featured will be the materiel and conservation programs. Pooling programs will also be discussed.

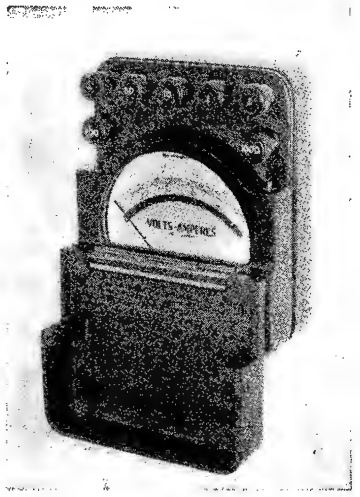
THE INDUSTRY OFFERS . . . —

PORTABLE A-C/D-C INSTRUMENTS

New P-14 portable a-c and d-c instruments for general field service use where an inexpensive unit is required, have been developed by the Westinghouse Electric and Manufacturing Company.

The instruments are enclosed in molded cases fully insulated and magnetically shielded from stray field influence. The scale length is 3.2 inches a-c and 2.8 inches d-c and the units have an accuracy of + or —1 per cent of full scale. They are equipped with a mirrored dial and a knife-edge pointer which aids in making close and accurate readings.

The P-14 embodies a variety of single and multi-ranges providing for the measurements of a-c volts, amperes and milliamperes: d-c volts, amperes, milliamperes, and micro-amperes.



* * *

DUREZ 11934

A new high-impact plastic of the phenolic type known as Durez 11934 was recently announced by Durez Plastics & Chemicals, Inc., of North Tonawanda, New York. It has a macerated fabric filler and consequently is not readily preformed. It has an impact strength of 2.0 and a specific gravity of 1.44. It is said to have a very good cure cycle for a material of this type and is available in black or brown color. Durez 11934, it is stated, will meet the special impact requirements that are required for such applications as small pulley wheels, casters, rollers, etc.

* * *

VACUUM TUBE VOLTMETER FOR A-F

Measurements throughout the entire audio frequency range, including the ultra-high audio frequencies, are simplified by a new Model No. 666, a vacuum tube voltmeter, designed by Radio City Products Co., 127 W. 26th Street, New York City.

Essentially a peak type of voltmeter, the unit has a constant input impedance resistance of 16 megohms. Although designed for 105-130 volt, 60 cycle operation, provision has been made for external battery operation through appropriate terminal connections and a throw-over supply switch. The instrument is equipped with a 4½-inch rectangular meter having a movement of 0-200 microamperes. Ranges are

(*Continued on page* 33)

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGONIGLE, President — RCA BUILDING, 30 Rockefeller Plaza, New York, N. Y. — GEORGE H. CLARK, Secretary

CHICAGO

WE have a duplicate report of the dinner held in Chicago simultaneously with our annual dinner in New York. (We explained in a previous issue that we had mislaid the original.) Stan B. Cappell, elected chairman of the Chicago Chapter, succeeding Bill Halligan, reports: "On February 21st last, the Chicago Chapter of VWOA elected the undersigned as chairman. L. R. Schmitt of the Teletype Corporation was elected secretary, and an executive committee and a committee on membership were designated. Dues were collected from fourten of those present.

"Mr. Schmitt and I are both desirous of having a fully paid and well represented Chicago Chapter. We ask your support."

We are most appreciative of Mr. Cappell's fine spirit of cooperation and assure him of our full cooperation.

WAR

OUR Nation needs trained communications personnel. There must be many among our veteran wirelessmen, not now engaged in vital industries, capable of doing a fine job of beating the Axis. Any person who has at anytime served in the communications industry can be of some help to our country. Don't sit around waiting to be asked to help. This is a job for all of us. The sooner we complete it the better for all of us. Remember—it must be done—and soon! If you have not already registered with some government agency offering your training and experience we shall be glad to forward your record to the agencies involved. Let us have a complete record of your training and experience.

PERSONALS

OUR Number One Life Member, David Sarnoff, president of the Radio Corporation of America and a real pioneer in the wireless art was recently called to active duty as a Colonel in the Office of the Chief Signal Officer of the Army stationed in Washington, D. C. . . . Hal Styles continues active as chairman of our Los Angeles Chapter with Max Schaeffer as secretary. Hal, together with the former secretary Leroy Bremmer, who is now on a secret mission, did a swell job on many VWOA activities in the LA area. We know Mr. Schaeffer will do a good job. . . . James Lawrence Fly, chairman of the Federal Communications Commission and of the Board of War Communications, was recently sworn in for another seven year term as a member of the FCC, following unanimous confirmation of his nomination by the United States Senate. Mr. Fly is an honorary member of our Association and has been most cooperative in Association matters. Sincere congratulations JLF. . . . Our best wishes to Niles Trammel, president of the National Broadcasting Company, an honorary member of our Association. Mr. Trammell is recuperating from a serious operation and we join his many friends in wishing him a speedy recovery. NT has always been most cooperative. . . . We haven't heard from our usually very active chapter chairman, George Street of the Honolulu chapter for many moons. We are sure he could provide us with some interesting material for this page. George will you please see what you can do? We feel sure the Japs haven't got you and they won't. . . . We again ask for you, our members, to provide us with material for this page. Let's know what you are now doing. It will interest the rest of us to learn of your activities. . . . Congratulations to Jack Poeppele, recently elected to a fellowship in the Radio Club of America.

ON THE RECORD

IN 1912, or thereabouts, when it was decided amongst most of the progressive nations of the world to establish some control of wireless communication, it was the proud duty of a young American, the first expert Radio Aide in the United States Navy to develop an examination to test the qualifications of applicants for licenses as Commercial Wireless Operators. George H. Clark, secretary of our Association, was the Aide. Because of age limitations our prexy did not obtain his first commercial operators' license until January 1925. Of all the accomplishments of those of our members who have risen to prominence in the industry we have always found them most proud of their work as professional wireless operators.

REMINISCING

VETERAN wireless men seem to like to hear about the past—and it is well that they do in these days, when any reference to the present comes under the head of "military secrecy." One of the most prolific story-tellers of the old days is William S. Fitzpatrick, who sailed over every square inch of the Atlantic Ocean in his long career as operator, many years ago. It would be impossible to get him to tell personally his stories of the olden times, but he has put himself on record in many articles written long ago, so here they are to confound him —and interest you.

"Memories of olden days. . . . Signing the articles at twenty-five cents a month, later reduced to one cent a month, just so you would be "on the books." . . . Saving a ship from peril through the use of a pocket flashlight, following the blowing up of the Diamond Shoals Lightship almost within sight. . . . The lead-covered code books, to be thrown overboard at once in case of possible capture. . . . Obtaining an English license, one of the only three ever issued to other than British subjects.

"Technical article of thirty years ago: Purchasing a bar magnet and some candles when buying an audion, the first type of vacuum tube. Heating the tubes made them more likely to oscillate; bending the stream of electrons by the magnet increased the sensitiveness.

"Airless wireless. Way back in 1910, a writer insisted that he got better reception with the windows and doors open! So E. N. Pickerell plugged all cracks, keyholes, etc., with wax, attached the receiver to a bedspring, and got Atlantic City very loud, though his receiving station was in New York. For a crystal detector, that was a record, and it effectively killed the 'free air' idea."

THE CLEVELAND IRE CONVENTION

(*Continued from page* 20)

through a total of 28 class A or class B linear stages, explained Mr. Fancher. The modulation process takes place at the studio where the composite signal plate modulates a pair of 6J5 tubes. The low level modulation scheme has several advantages . . . (1)—none of the stages following the modulator will need to be altered to accept any type of synchronizing pulse which may later become standard, such as the f-m pulse . . . (2)—the system will accept f-m for the picture without change . . . (3) with the studio remote from the transmitter, which is the case of WRGB, some noise and distortion are avoided by not having to demodulate at the transmitter . . . (4)—more power is obtained from the output stage than would be possible if it were grid modulated. This is due both to the higher efficiency of the class B linear stage, explained Mr. Fancher, over a grid-modulated stage, and to the fact that the plate circuit need be only 4.75 mc wide, when the final stage is a linear amplifier instead of 8 mc for a final modulated stage. Thus, we have a proportional increase in power output and the elimination of any loss in an antenna filter. The fifth point is concerned with low level plate modulation, as compared to high-level grid modulation, it being possible to produce the negative peak 100% modulation for maximum white and also to modulate further with less distortion. In the sixth point, Mr. Fancher explained, we find that since all the r-f stages are tuned to reject the lower side band below minus 0.75 mc from the carrier, it is unnecessary to provide a complete vestigal side band filter in the antenna transmission line circuit.

Another feature of the system is the horizontally polarized antenna, said Mr. Fancher. This is a stacked array of four bays of large diameter, shortened half wave dipoles with driven directors. The elements are phased to give a maximum radiation in the horizontal plane and are connected to the transmission line by a system of matching sections, explained Mr. Fancher. These consist of parallel bar, quarter wave transmission lines with adjustable spacing. The whole antenna is enclosed in a wooden structure to avoid the detuning effect of ice and snow on the antenna.

A unique horizontal rhombic antenna is used to receive signals from Schenectady. There are three wavelengths on a side, mounted on the top of a 6-foot pole. A gain of 7.3 db is achieved with this antenna over a single diplole. Of approximately 700 ohms impedance, the antenna is coupled to a single 70-ohm ⅞-inch diameter concentric line through an inductively coupled tuned, wide-band transformer. The signal from the New York relay is received on a dipole with a driven director, explained Mr. Fancher. This antenna is similar to a single bay of the transmitting antenna from the Schenectady studio and is connected through a matching section to a 100 foot ⅜ inch concentric line to the receiver terminals. The signal level at the receiver terminals is one millivolt peak.

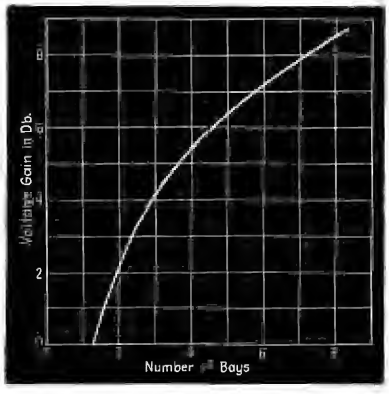
There are six stages of the type GL-956 acorn tubes operating as class A amplifiers at the 163.25 mc carrier frequency in the receiver. Each stage is coupled to the following one by a double tuned, inductively-coupled circuit loaded to give a 3% dip at the center of the pass band, said Mr. Fancher. After this amplifier follows a GL-832 converter. In this circuit, the signal frequency is fed to the grids and the fixed frequency of 96 mc is fed in parallel at the midpoint of the 163.25 mc grid coil. The signal from the converter is approximately one watt at the output frequency, said Mr. Fancher.

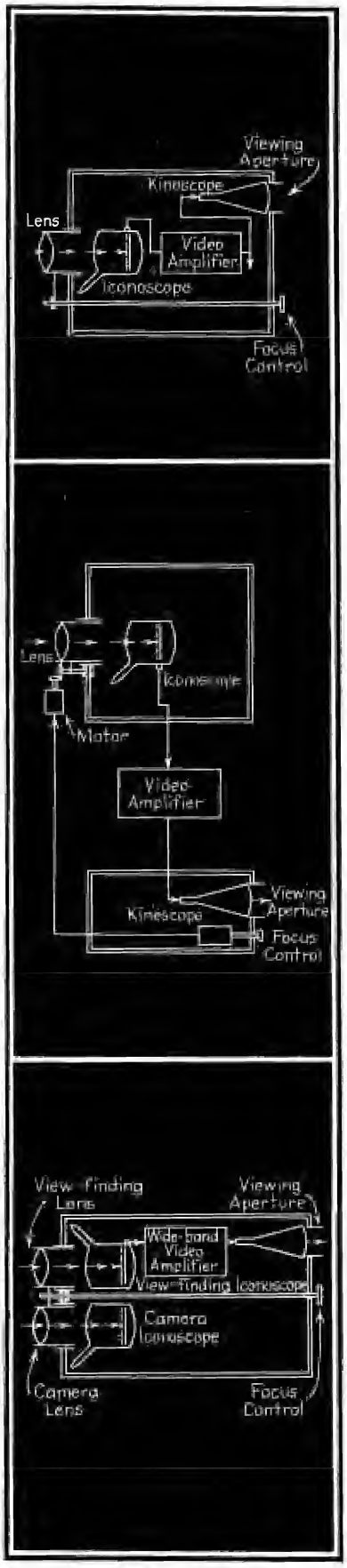
Alignment of the transmitter circuits is affected by connecting a motor-driven

(*Continued on page* 34)

Figure 20

Gain of the circular antenna compared with a vertical half-wave dipole. Each bay is spaced a wavelength apart. (See page 36.)





Figures 21, 22 and 23

Figure 21, top, kinescope or electronic view finder. Figure 22, center, electronic finder with remote control. Figure 23, bottom, combination duplicate lens and electronic view finder. (See page 37.)

MANUFACTURERS

Thousands of engineers associated with the radio, television, broadcast, recording and two-way communications fields—commercial and governmental—want to read about your new products in COMMUNICATIONS. Send complete data to the editor.

NEWS BRIEFS

(*Continued from page 22*)

and voltmeters and a-c ammeters, voltmeters, wattmeters, frequency and power factor meters, synchroscopes, rectangular triplex ameters, and horizontal edgewise triplex ammeters. Round surface mounting models and square surface or flush models are listed and described.

Copies may be obtained without charge.

* * *

RAY AND MANDERNACH WIN NEW G.E. POSTS

F. A. Ray, manager of the Musaphonic Division since its inception, has been named Eastern Regional Sales Manager of G.E. Receiver Division at Bridgeport, and will assist A. A. Brandt, sales manager of that division. He also will continue as manager of Musaphonic Sales.

H. J. Mandernach, G.E. district radio representative in the central west for the past six years, has been named a member of the headquarters staff in the Tube Sales Division of the G.E. Radio, Television and Electronics Department at Bridgeport.

* * *

CHEMICAL LAB DATA

A radio chemical laboratory with twenty items used in service, maintenance and laboratory work, is described in a data sheet, released by the General Cement Company, Rockford, Ill.

The chemicals are in 2-ounce bottles, that are fitted to a special rack, for hanging or bench mounting.

* * *

SYLVANIA TUBE DIVISION CHANGES

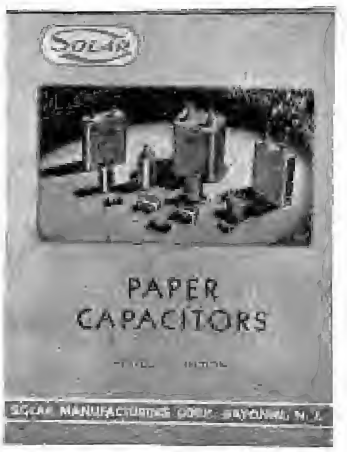
H. Ward Zimmer, general manufacturing manager, has been appointed general manager of operations of the Receiving Tube Division of Hygrade Sylvania Corp., which includes three plants in Pennsylvania and one in New England.

R. M. Wise, chief radio tube engineer, has been named general manager of operations, Special and Large Tube Division, which includes three other Pennsylvania plants.

* * *

PAPER CAPACITOR CATALOG

Solar Manufacturing Corp., Bayonne, N. J., have published a 48 page catalog known as Catalog 12-section C. The compilation covers complete description of a variety of paper capacitors, with constructional, mechanical and electrical characteristic tables and charts. Copies may be had by addressing Solar on your company letterhead.



THE INDUSTRY OFFERS . . . —

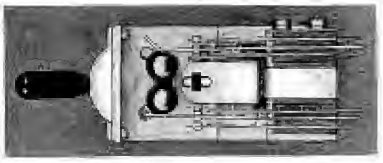
(*Continued from page 27*)

0-3-6-30-150 volts. Tubes used are type 6K6GT, 6X5GT, 6H6 and VR105-30.

* * *

CAM LEVER SWITCH

General Control Company, 253 Broadway, Cambridge, Mass., have produced a new master cam lever switch, having single volt assembly and no sliding friction. Unit has static shielding between build-ups. The switch can be had with practically any number of contact build-ups in each of the four positions and can be made lock or spring return on the cam action. Contact ratings are 10 amperes 125 v, or 2 amperes 125 v, d-c. New 4-page illustrated catalog MCL 20C available.



* * *

AIRCRAFT RECEIVERS AND TRANSMITTERS

A 3-purpose aircraft receiver, Model 108, for beam, weather and traffic, interlane reception and two-way interphone communication is now being made by Electronic Specialty Company, 3456 Glendale Boulevard, Los Angeles, Calif. A companion transmitter, Model 203, is also being made.

A receiver identical to the Model 108, but operating from a Model 503 power supply, instead of dry batteries, is also available. A companion transmitter to it, Model 206, with an output of 10½ watts, is also produced for use with the same 12-volt power supply.

* * *

CLOTH WITH INK-LIKE RESULTS

A tracing cloth for pencil use, that is said to offer a high degree of transparency and ink-like density, is now available from the Frederick Post Co., Hamlin and Avondale Aves., Chicago, Ill. The paper, called PENCILTEX, is said to be anti-smudge. It permits the use of a 5H or harder pencil and produces the same dark, dense line as a 2H or 3H on ordinary tracing cloth. It is available in 20-yard rolls in widths of 30, 36 or 42″ or in sheet sizes to fit your needs.

THE CLEVELAND CONVENTION

(*Continued from page* 30)

sweep oscillator to the receiver input terminals. This sweep frequency band is somewhat wider than the transmitter pass band, explained Mr. Fancher, so that visual alignment is possible by using diodes permanently connected to the grid of each stage. These diodes are constructed to pass the video band so that their output can be used to operate the picture and wave-form monitor.

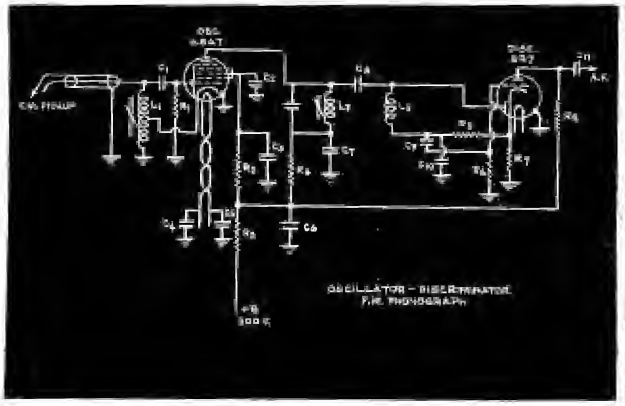
For transmitting sound, an antenna consisting of a cubic array of eight quarter-wave elements fed at opposite corners and phased to give some horizontal directivity as well as a circular free space field pattern in the horizontal field is used. This antenna is mounted on a 60 foot pole.

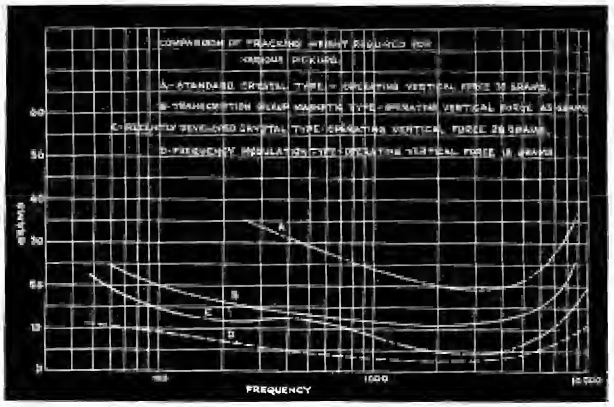
RELAYING TELEVISION SIGNALS

THE transmission of television signals over relay "air" systems instead of over coaxial lines and line repeater systems has become an effective medium. One of the most successful applications of such relaying is that employed by WNBT and WGRB, over a 130 mile span, where the receiving station is over a mile below line of sight from WNBT, the station originating the programs. This unusual relaying system, discussed by J. E. Keister of General Electric, employs a 400 feet long by 150 feet wide single rhombic antenna, supported by four steel towers 128 feet high. To minimize any mis-match in the direction of the receiver, a 600 ohm resistor is connected to the free end of the rhombic, preventing appreciable re-reflection of signals to the receiver. In addition, this makes the antenna unidirectional. A double tuned, inductive-coupled circuit is installed between the antenna and the receiver line to match the rhombic impedance of 600 ohms balanced to a single ended, 70 ohm 7/8 inch diameter concentric line.

Through the medium of six amplifier stages operating at the incoming signal frequency, the low input level is increased. In the first five stages are 6SG7 tubes and in the last a GL-1614. The input and each succeeding plate-to-grid circuit is a double tuned inductively-coupled transformer, said Mr. Keister. This coupling and secondary loading of each stage is adjusted to give a band width of 4.75 mc, with an over-coupled voltage dip of 3% at the center. The resulting over-all gain of these stages is in the order of 250,000, explained Mr. Keister.

De-modulating is not used in the relay process in this system, because there is the possibility that some form of frequency shift during synchronizing may be used experimentally and later adopted as a standard. Considerable difficulty would be encountered in reproducing such a pulse in the re-radiated signal after a de-modulation process, explained Mr. Keister. Simple conversion, with a fixed local oscillator,





Figures 24 and 25
Figure 24, left an oscillator-discriminator circuit for an f-m phonograph system described by C. M. Sinnett. Figure 25, right, chart plotted to show weights of pickups as compared with the f-m type. (See page 39.)

maintains any such frequency modulation signals intact. A second reason for not de-modulating, said Mr. Keister, is the probable increase in amplitude distortion which would accompany the re-modulation process.

The frequency control system chosen is independent of frequency drift of the received signal since it depends for its action on the comparison of the transmitter frequency with a harmonic of a local crystal oscillator, explained Mr. Keister. This places complete control of the output frequency at the relay station and fulfils the FCC requirement that frequency be controlled locally, said Mr. Keister. In explaining the principle of operation, Mr. Keister said that the voltage of the output frequency is mixed with a harmonic of a crystal oscillator in a converter tube to produce an i-f of 4.05 mc. This signal is then amplified through a single stage narrow band amplifier (6AB7/1853) to a discriminator and a 6H6 diode circuit. There results a d-c voltage proportional in magnitude and with a polarity in a direction to correspond to the deviation of the i-f signal from the discrimator null point.

The low frequency of 4.05 mc and narrow i-f band of 80 kc was chosen because, said Mr. Keister, (1)—the temperature drift or other causes of deviation of the discrimator nil corresponds to a relatively small error measured in cycles, and thus a negligible error in percent of the output carrier frequency . . . (2)—the standard television signal requires a double side band operation from 0 to .75 mc modulation. The narrow i-f band will accept frequencies within only plus or minus 40 kc of the carrier. As a result there is no correction voltage derived from the unbalanced side bands of the higher modulating frequencies . . . (3)—for the same reason, the system will feel no correction voltage during the .75 mc frequency shift of an f-m synchronizing pulse. A long time constant in the d-c correction circuit holds the master oscillator on frequency over these short periods of no control.

The aural signals are received on a conventional f-m set, with a two stage limiter and standard discrimator. The a-f is fed over telephone lines to the main transmitter from a monitoring and switching rack. There are two such lines available, providing a spare program or communication line.

During actual use, the signal strength

(Continued on page 36)

(Continued from page 35)

at the receiver input is better than 300 microvolts.

TELEVISION STUDIO LIGHTING

WATER-COOLED mercury lamps, originally tried out in the television studios of General Electric at the New York World's Fair in 1939, have gone through a succession of developmental stages that have resulted in new high luminosity tubes. Such tubes have been installed in the television studios of G.E. in Schenectady, and the subject of study for over a year. The collected data was analyzed by H. A. Breeding of General Electric.

The studio in which these lights are used is 42 by 70 feet, with approximately 18 feet ceiling height between beams. In presenting lamp and floodlight characteristics of these tubes, Mr. Breeding explained that the 1,000 watt water cooled mazda H lamp offered approximately 65,000 initial lumens. The average footcandles with all of the floods pointed downward and oriented with the long axis of the reflector across the room was 315 footcandles, said Mr. Breeding. It is possible to build up the intensity over a 10 x 15 x 10 foot high scene to 650 or more footcandles of general lighting, with the upper portions of the scene reaching 1000 footcandle. By supplementing this lighting with the floor lamps, good pictures are produced with little or no discomfort to the performers, explained Mr. Breeding.

CIRCULAR ANTENNAE

A CIRCULAR antenna that features simple horizontal polarization with only two terminals, yet essential uniform horizontal radiating properties was recently designed by M. W. Scheldorf and L. M. Leeds of General Electric. It received its first public launching at the convention, with co-inventor Scheldorf describing the unusual device.

In addition to the first mentioned features, the antenna also affords low mutual between vertical bays which greatly improves adjustments of multibay installations, and covers a wide frequency range with one physical structure by simple means. In addition, the system may be easily mounted to a pole of any diameter and grounded to that pole so that there is lightning protection. It may be applied, too, to metallically covered vehicles, such as motor cars and trucks, to an advantage. And its design also affords sleet melting, if desired.

In this antenna, the upper and lower

circular elements, are each effectively a quarter wavelength long, being shortened from a physical quarter wavelength by an end capacity. Obviously adjustment of the size of this end capacity, said Mr. Scheldorf, serves to provide adjustment to resonance at any frequency over a frequency range, without change in the main physical structure. The adjustable capacitor used is of heavy micalex plates with conducting plates on each side similar in arrangement to an automobile spring. This reduces the susceptibility to capacity change due to a collection of snow and ice, explained Mr. Scheldorf. The radiating elements are constructed of standard steel pipe, while the relative diameters of the primary system and secondary system are determined by the degree of impedance boost desired.

In Figure 20 appears the gain characteristic of this antenna. From this curve it is obvious that there is an improvement due to large spacing over antenna systems which require a closer spacing for the highest gain. This, said Mr. Scheldorf, agrees with the generally accepted condition that the gain of an antenna system is determined by the total "aperture," provided the spacing is near to the value which gives the optimum gain.

A four bay antenna system using the circular antenna system connected for high power work is shown in Figure 19. The elements near the base are the familiar phase inverting elements or elevators, said Mr. Scheldorf. This makes it possible to connect a balanced load to a single ended concentric transmission line. Mr. Scheldorf explained that he used the word "elevator" because the addition of the outer shield elevates the potential of the outer conductor of the transmission line above ground. For a two bay installation only, one of these elevator elements is used, connected in identical manner to its associated two antenna elements.

The original single unit used for determination of the basic characteristics, is now in operation at the New York Muzak station, W47NY, said Mr. Scheldorf. Other stations in Philadelphia and Chicago have also received these antennas.

TELEVISION CAMERAS AND FOCUSING VIEW FINDERS

IN a television camera, one of the most essential elements is the view finder. A variety of focusing view finders have been developed over the past ten years, each offering characteristics suitable to particular installations. An investigation of these characteris-

(*Continued on page* 38)

(*Continued from page 37*)

tics, together with practical operating experience has established certain requirements that an ideal view finder should meet. These requirements were discussed by G. L. Beers, RCA Manufacturing Company, who pointed out that there were five requiments for an ideal view finder . . . (1)—at all times, the finder should accurately indicate when the camera is in focus on the desired scene or object . . . (2)—the view finder should not only define that portion of the scene which is being converted into the television image, but also should reproduce a sufficient portion of the scene outside the camera field so that the camera man will know in advance what the television picture will include if he pans the camera in any direction . . . (3)——there should be provision for an erect image which is correct left to right and of sufficient size and brightness to minimize eye strain . . . (4)—the view finder should not unduly complicate the procedure of interchanging camera lenses or pickup tubes . . . (5)—for portable work the view finder should not contribute substantially to the size and weight of the camera.

Seven types of view finders were described by Mr. Beers. These were . . . (1)—mirror arrangement for observing the optical image on the mosaic . . . (2)—semi-silvered mirror arrangement for utilizing the camera lens to produce an optical image on a ground glass viewing screen . . . (3)—kinescope or electronic view finder . . . (4)—kinescope view finder with remote focusing control . . . (5)—split image view finder as used in the contax and similar cameras . . . (6)—duplicate lens view finder as used in the rolliflex camera . . . and (7)—combination duplicate lens and kinescope view finder.

The first four view finders, said Mr. Beers, can be classified as being in the first requirement group, while the remaining finders are in the second group.

In Figure 21, appears one of the view finders discussed; the kinescope view finder. The chief advantage of this system, said Mr. Beers, is that the relative brightness of the image does not diminish as the sensitivity of the pickup is increased. The brightness of the kinescope view finder image, explained Mr. Beers, is determined primarily by the characteristics of the kinescope which is used and the operating voltages used. In Figure 22, we have a kinescope finder with remote focusing control. The advantage of this system lies in the fact that a small size camera, light in weight can be used, a desirable feature in portable pickup work. The limitation is, of course, that a fairly high degree of coordination is required between the man

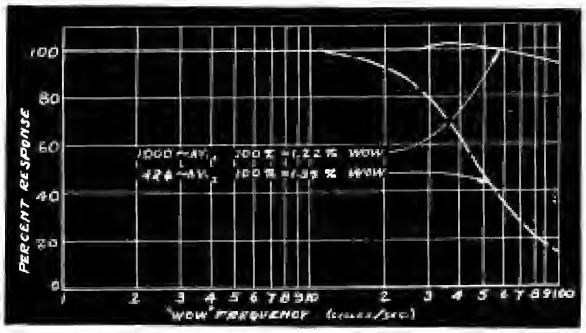


Figure 26
A "wow" response result, with a constant voltage input, plotted by H. E. Roys. (See page 42.)

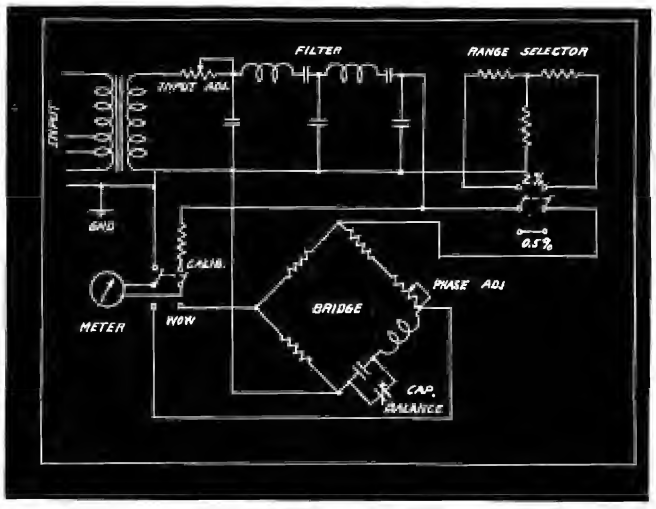


Figure 27
A bridge circuit for a wowmeter, that serves to provide an overall measurement of "wow" content. (See page 42.)

who is panning the camera and the man at the remote point who is operating the focusing control. Figure 23 illustrates a combination duplicate lens and kinescope view finder discussed. Two pickup tubes are used with a pair of duplicate lenses. The amplifier used with the view finder pickup tube, said Mr. Beers, is designed to pass a wider frequency band than is normally required by the television system. This increases in resolution, which the wider frequency band permits. This enables this view finder to provide a more accurate indication of focus than could be obtained from the other kinescope view finders, explained Mr. Beers.

RECORD REPRODUCTION SYSTEMS

WITH the increased interest in phonograph records have come increased efforts to improve overall performance of record producing systems. Many studies have been made of the methods possible to increase fidelity. One such investigation was made by G. L. Beers and C. M. Sinnett of RCA Manufacturing, a review of which was presented by Mr. Sinnett at the convention.

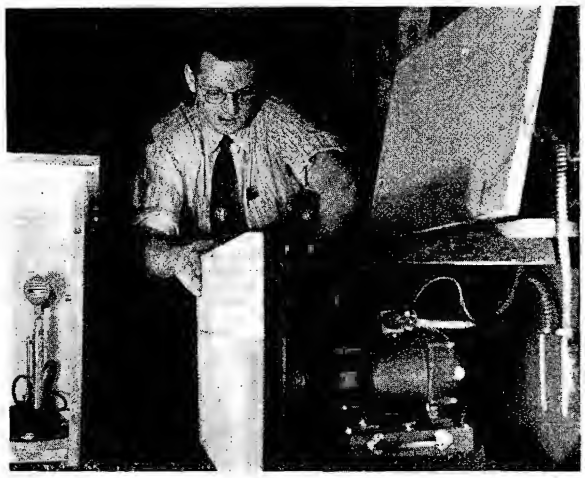
A phase of the investigation was directed towards the possibilities of reproducing frequencies up to 10,000 or 12,000 cycles from standard shellac records, without the introduction of objectionable surface noise, said Mr. Sinnett. Six factors were found to govern the pickup requirements for satisfactory reproduction of lateral cut records. One of these was the vertical force required for satisfactory tracking, said Mr. Sinnett. Tests made indicated that for lacquer records the vertical force should not exceed 20 grams, while a maximum value of 30 grams is considered satisfactory for shellac records. The second factor was the mechanical impedance. The third was the free resonance of the pickup. In this instance, Mr. Sinnett explained that experimental evidence indicated that it is desirable to keep the free resonance of the pickup at as high a frequency as possible to minimize the effect of ticks and other record groove irregularities. The fourth factor concerned the relationship between the stylus displacement and the audio output. The fifth factor covered the frequency response characteristic. A phonograph pickup suitable for high fidelity system, said Mr. Sinnett, should provide a frequency response throughout the useful audio frequency range which is proportional to either the amplitude or the velocity of the modulation in the record groove. The sixth factor concerned the sensitivity of the pickup, which should be such that the amplification required between the pickup and the loudspeaker is not so great as to introduce serious microphonic difficulties, said Mr. Sinnett.

In a review of these requirements, it was found that with a simple specially designed pickup a f-m signal could be reproduced, explained Mr. Sinnett. This signal had sufficient frequency deviation to provide a relatively high audio frequency output when applied to a simple frequency discriminator and rectifier combination. Either the inductive or capacitive reactance of a resonant circuit can be varied to produce a desired frequency shift, said Mr. Sinnett. In the experimental f-m pickup described, a metal frame or mounting block is provided as a support for an insulated plate which is the high potential side of the pickup. To this mounting block is attached a thin metal ribbon. This is mounted in a plane parallel to the insulated plate and space from it by a small air gap. It is placed under tension in order to increase the natural resonance frequency of the system. Displacement of the stylus laterally results in a change in the position of the ribbon with respect to the fixed plate, explained Mr. Sinnett, and thus

(*Continued on page* 42)

STAR SPANGLED NETWORK

(*Continued from page* 10)



A view of the mobile truck . . . the blue division of the Network. The engine used to supply power to the recording device is a four-cycle gas engine, two-cylinder unit, driving an a-c generator of 350 watts capacity.

boys desire to hear or make specific recordings. The instruments used are standard makes, with standard discs such as glass base type, being used for transcription purposes. For recording of 'home-type' messages in either the permanent or mobile units, a fabricated fiberoid paper type of disc is used, among the standard styles.

This paper disc is unique in that it affords the printing of messages over the entire surfaces, in addition to the writing in of messages. It is composed of a series of laminated jute sheets. They are pressed under terrific pressure until co-hesion is achieved.

To withstand the coating emulsion and the series of temperature changes each disc goes through, certain color pigments in the inks must be specially treated. The inking is fortified by an automatic gun that sprays each disc individually with a sealer that eliminates color-running. The discs are also subjected to the customary peak-heat, humidity and frigidity temperature conditions.

Before the discs are coated, they are cut to size and drilled for racking, as illustrated on page 10, at bottom.

In addition to the strictly local wired radio broadcasts between the USO clubhouse and the military post, some of the programs originating from the club have been picked at the club by local radio stations. Thus the civilian communities have also been treated to these specially developed broadcasts, that most of the time are piped to the barracks only.

The educational and direct message feature of this wired radio system is very important for it affords the broadcast of lectures and special talks directly to every man at a single instance.

The studios are built by the local carpenters in accordance with material and physical specifications given to them. Every effort is made to produce such rooms that will afford the utmost in reproduction, without, of course, resorting to elaborate large scale broadcast studio construction. In many studios, miniature stages are built for theatre effect. Thus many can watch the broadcasts. In other instances, where space is at a premium, a small broadcasting type studio with glass window is built, with some space inside and outside for onlookers.

Transmitting from an amateur station during one of the trial USO broadcasts prior to Pearl Harbor. Admiral Woodward is in the rear, Carol Bruce in the foreground.

SUBSITUTE MATERIAL

(*Continued from page* 11)

substitute device is an improvement in quality over the original design, and is produced at lower cost.

The next example involves parts used on a small rotary inductor. The old design utilized an anodized aluminum alloy part for the housing. It had a machined aluminum alloy front plate and steatite end plates of the highest electrical grade. The new inductor looks similar to the one just described, but differs in several particulars. For instance, the steatite end plates have been changed to molded mycalex. The front housing, which was originally an anodized aluminum alloy part, is now a rag-filled black phenolic part, and the front mounting plate which was laboriously cut out of aluminum alloy sheet is now die cast in a more readily available aluminum alloy. By these substitutions we have increased the rate of production of the coils themselves and have eliminated the very large machining waste in the two aluminum parts. By substituting injection-molded mycalex for the steatite, we remove parts that were very difficult for steatite suppliers to produce. This allows the steatite suppliers to spend more of their time on those other items of steatite for which no good substitute seems available.

Another example is a small switch wafer and the rotor that is associated with it. These parts are used on a number of switches going into military radio equipment. They were originally made from steatite. Two things caused trouble in this design. With steatite it was difficult to maintain the close tolerances and the extreme degree of flatness required in the design. It also was necessary to work on the steatite parts and internally grind the stator and externally grind the rotor to gain the degree of mechanical precision needed in our electrical circuits. In addition, the riveting operations on ceramic parts led to a fairly high breakage factor which slowed up production and caused hardship to ourselves and to our customers.

The mycalex parts now being used are enough like their predecessors that identical mechanical items used with the ceramic parts can be directly attached to the mycalex pieces. The need for grinding to obtain close tolerances is removed, since a feature of the production technique used to obtain injection-molded mycalex, produces parts that can be maintained within extremely close mechanical limits. The impact strength of the mycalex items is appreciably higher than that of the steatite material, thus cutting down the breakage hazard experienced in the earlier design.

A word on costs is timely since the mycalex parts are appreciably more expensive than the ceramic items. When a greater knowledge of the process of injection-molding mycalex is gained, and more knowledge regarding the application of such parts is gathered, the overall cost of items in this order of complexity will show a net gain in favor of mycalex. We have reviewed all of our military apparatus lines in order to substitute injection-molded mycalex for all of the difficult steatite parts now employed whenever this action seems feasible, the object being two-fold:

(1) To relieve steatite production of difficult items and allow the steatite suppliers to apply this freed capacity on other items, such as coil forms, where we know of no suitable substitute.

(2) To expand the production knowledge of injection-molded mycalex and push it into even wider and more diverse fields.

As a by-product of the above program, we are saving man-hours and effort in one part of our war activity which permits applying these saved man-hours and efforts towards the expanded production being demanded of us on other war activities.

Many other interesting substitutions have been undertaken. One of these is the substitution of certain grades of zinc die castings for high-pressure cold-chamber aluminum die castings. In many cases the same dies and casting equipment that were used for high-pressure aluminum castings can be directly used for zinc casting work. Obviously, changes of this order require additional study of supporting parts, corrosion problems, and innumerable other factors. But such additional effort is not only justified from a common-sense standpoint, but may produce a useful advancement in the art of construction which we never would have realized, had we been able to maintain the relatively easy access to all materials which we enjoyed during the pre-war period.

Countless other cases of substitution, similar to the few mentioned here, are going on at our plant and throughout the industry.

It will be necessary for all to appreciate the problems that industry is now coping with, as the users in turn will necessarily have to accept variations in performance and different methods of construction. This proposition is certainly not one-sided, but must be attacked by manufacturer and user alike.

(*Continued from page 39*)

produces a change in capacity.

Figure 24 illustrates an oscillator and frequency discriminator-rectifier circuit which has given satisfactory results in this experimental f-m phonograph system. In this circuit, a simple resonant circuit is used as the means for converting the oscillator frequency variations into changes in the amplitude of the signal applied to the diode portion of the 6R7 tube, explained Mr. Sinnett. A powdered iron core associated with inductance L_2 is used to tune this circuit so that the mean oscillator frequency falls at approximately the 70% response point on one side of the selectivity characteristic. The oscillator tube of the 6SA7 type permits electronic coupling between the oscillator and the discriminator circuits.

Through the use of equations prepared in the course of the development of the system, the following characteristics were shown to have been calculated . . . (1)—lateral mechanical impedance . . . (2)—lateral force acting upon stylus . . . (3)—response characteristics of pickup and tone arm . . . (4)—tracking weight required to overcome the vertical force due to lateral velocity . . . (5) — tracking weights and relative outputs to be obtained with different radius stylii.

In conclusion Mr. Sinnett showed that the experimental f-m pickup meets the requirements of a satisfactory pickup, heretofore not attained in a relatively inexpensive device.

A STUDY OF 'WOWS'

A STUDY of the proposed standards of NAB show that one of the requirements of faithful reproduction is controlled by the maintenance of constant speed of the reproducing turntable. Equipment of a simplified nature that will evaluate the "wow" content or freedom from speed fluctuations, as a single figure is thus essential. A study of such equipment was undertaken by H. E. Roys of the RCA Manufacturing Company, Indianapolis, Indiana, as a member of the standards sub-committee of the NAB, and a review of this study was presented at the convention.

Mr. Roys described the first wow meter, designed by M. S. Mead of G. E. in 1929, for testing sound film reproducers. Based on the principles of this instrument, Mr. Roys developed measuring equipment some years later. For these measurements, a 1,000 cycle signal reproduced from a constant note record on a turntable was amplified and applied across a tuned circuit. This was tuned to a frequency slightly higher than the record frequency so that operation was on one side of the resonance curve. The amplitude modulated signal that resulted was rectified, the 1,000 cycle carrier filtered out, and the modulation corresponding to the variations in turntable speed measured by observing the deflection of a galvanometer light beam.

A similar arrangement is in operation in the RCA laboratories, said Mr. Roys, with certain modifications and improvements. In the newer instrument, two tuned circuits are used, one tuned above the operating frequency and the other below, providing a push-pull arrangement that smooths out and extends the operating range. Thus the equipment is insensitive to voltage changes. No records are used in the new arrangements. Instead a magnetic tone wheel with a number of laminations with machined teeth around the periphery and clamped together in the rim of a cast aluminum wheel, is used.

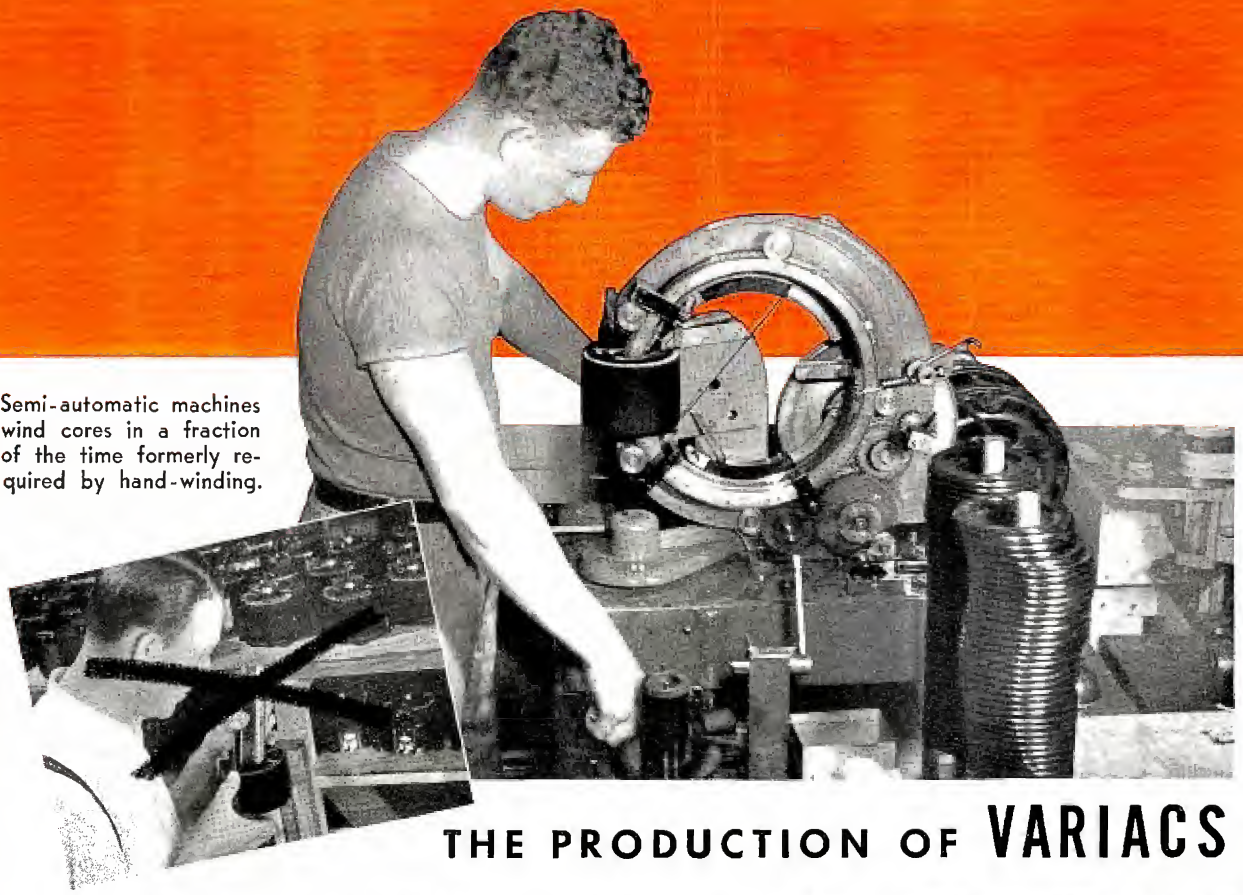
Two pickups are mounted diametri-

cally opposite on a bridging structure, explained Mr. Roys. These are supported from a spindle centrally located on the tone wheel. Each of the pickups have pole pieces with corresponding teeth and separated from the tone wheel by a small air gap. The tone wheel is used at both 78 and 33 1/3 r.p.m., the resulting frequency at the latter speed being 426 cycles per second and the former 1,000 cycles, said Mr. Roys. Measurements are made by observing deflection on a galvanometer light beam.

This equipment is primarily for use in laboratory work, and not for evaluation of the wow content in terms of a single figure, said Mr. Roys. For overall measurement, wowmeters or flutter bridges can be used, he pointed out. The circuit illustrated in Figure 27, represents such a device that is used extensively by the RCA service department, said Mr. Roys. In operation, the capacity-inductor branch is tuned to the average carrier frequency and any departure therefrom unbalances the bridges, and affords a measurement on the meter.

Expressing the wow content as a single figure in terms of peak to peak values, has become a standard of expression, said Mr. Roys, since wow meters gave results in the form of oscillograms. That is, the difference between the maximum and minimum speeds attained during the period covered by the oscillogram. . . six seconds . . . is expressed as a percentage of the average speed, explained Mr. Roys. While this is a convenient way, it is not an ideal way, continued Mr. Roys, since it gives the equal rating to a speed variation which only occasionally reaches the peak value and a sine wave variation of the same peak value. Wows can depend on the duration of the deviations of the average speed, within limits, and upon the amplitude or percentage change varying at a rate greater than the first power, showed Mr. Roys. Thus, he continued, if this is true, an rms reading would probably be a good way of expressing the wow content as a single figure. For a true reading, a thermo-couple meter should be used, since wowgrams show the speed variations to be complex and far from a simple sine variation, explained Mr. Roys. However, since a thermocouple is delicate, a rectox meter would probably be more suitable, said Mr. Roys.

Index of Advertisers



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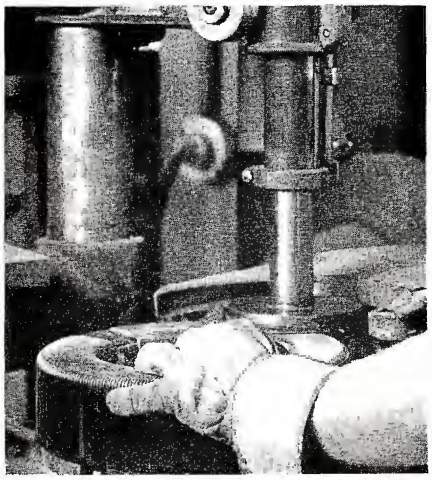

Grinding the commutator surface on a type 50 Variac winding.

Variacs are made in 15 models with power rating from 90 watts to 7,000 watts; prices on the stock models range from $10 to $100.

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GENERAL RADIO COMPANY
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—the original continuously variable autotransformer supplying an output voltage from zero to *above* line voltage.

Because practically all of our manufacturing facilities are devoted to war projects, to secure this equipment a preference rating certificate or other approved priority rating will be necessary.

STEATITE

TEN QUESTIONS...AND ANSWERS

IMPORTANT INFORMATION TO ANYONE CONCERNED WITH DESIGN OR PRODUCTION OF ARMY OR NAVY RADIO EQUIPMENT

Q. *What is Steatite?*

A. Steatite is the term applied to a certain type of low-loss ceramic. It also applies to the principal raw material from which such a ceramic is made.

Q. *What are the uses of Steatite?*

A. Its low-loss characteristics make it almost necessary for radio-frequency circuits. Tube socket bases, switch parts, coil forms, standoff insulators, bowl insulators, rod antenna insulators, etc., are pieces in regular use.

Q. *Is there a shortage of Steatite?*

A. The raw materials of Steatite are available in great abundance. In fact, the Lapp supplier of Steatite talc reports his business substantially reduced, due to reduction in output of non-war ceramics. Facilities for the production of finished pieces of certain types are not sufficient to fill the requirements of the armed forces.

Q. *In what sort of pieces does this shortage exist?*

A. Small close-tolerance pieces (tube socket bases, switch parts, coil forms, etc.) require a precision manufacturing technique for which facilities are not easily amplified.

Q. *What is Lapp's part in the supplying of Steatite?*

A. Lapp facilities are available for the production of a large volume of Steatite, in certain types of pieces.

Q. *What sort of pieces is Lapp equipped to make?*

A. Steatite in larger pieces—that do not demand close tolerances—pieces that can be made by extrusion, formed by turning, throwing, plunging or casting, are producible by regular Lapp processes. These include standoff insulators, rod antenna insulators, bowl entrance insulators, bulk-head insulators, streamline entrance insulators, etc. For production of such pieces in Steatite, Lapp facilities are almost unlimited.

Q. *What are Lapp qualifications for Steatite production?*

A. Lapp engineers have four years' experience in the peculiarities of Steatite production. Shrinkage, glazing and firing problems have been solved. Complete testing facilities in the Lapp laboratory include a radio frequency generator (with range up to 3,000 Kc and 40,000 volts) for making heat runs, corona tests and flashover determinations. By maintaining a close check on radio frequency characteristics—dielectric constant, power factor, puncture strength, etc.—Lapp can assure performance characteristics of finished pieces.

Q. *What* can't *Lapp make?*

A. Lapp has limited facilities for pressing, and is not equipped to make small close-tolerance pieces.

Q. *What of hardware?*

A. For pieces requiring sanding and cementing into hardware, Lapp methods are perfectly suited. (This, like the production of a large volume of heavy Steatite pieces, fits right into normal Lapp insulator production methods.)

Q. *What should you do when you need Steatite pieces?*

A. Such pieces as can capably be produced by Lapp should be ordered from Lapp. Other Steatite Manufacturers, thus released from this part of the load, will be free to increase production on those pieces which they alone can manufacture efficiently. Such a program will reduce the over-all shortage of Steatite, and will accelerate the war effort.

Lapp

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